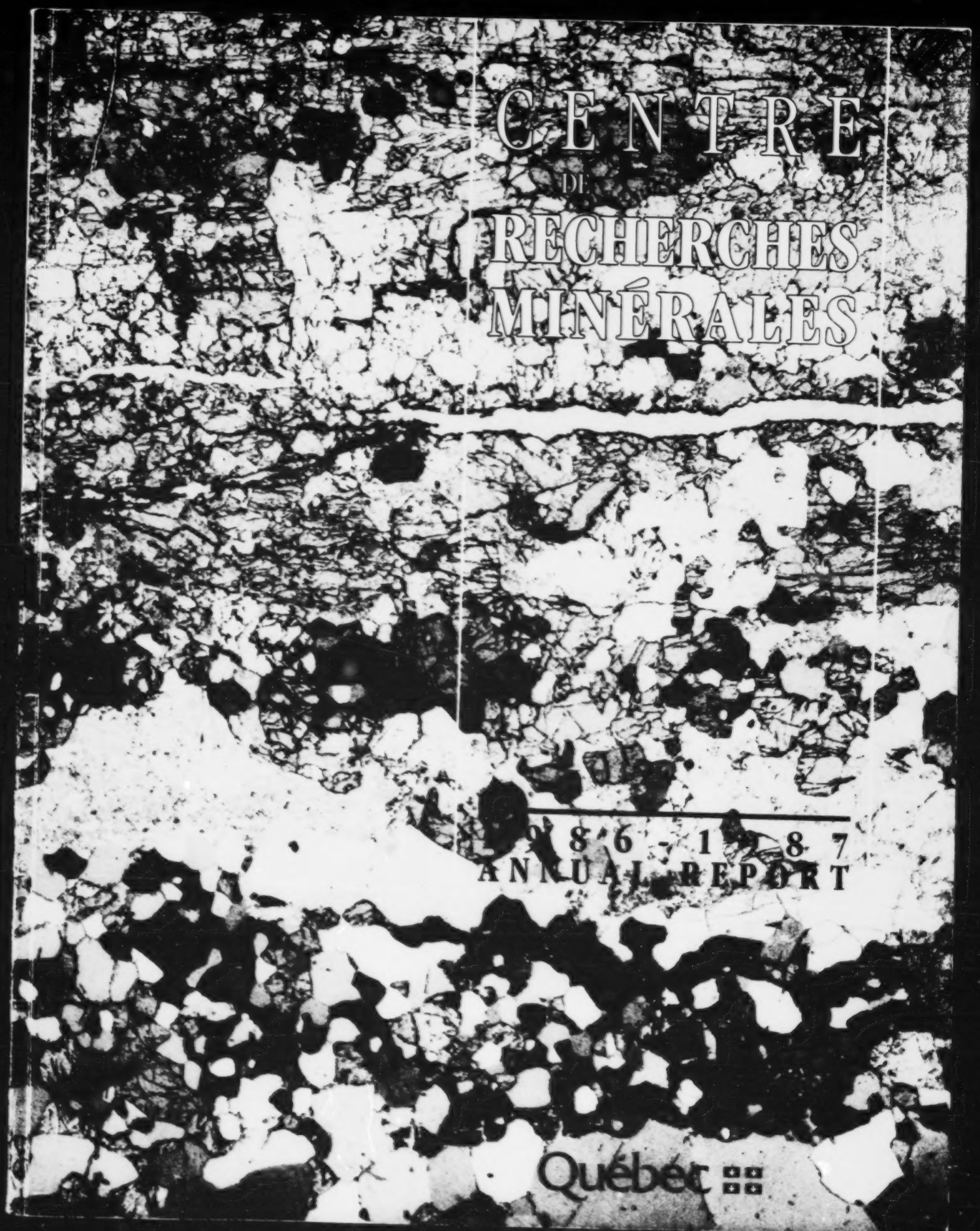

CENTRE
DE
RECHERCHES
MINÉRALES
1986-1987
ANNUAL REPORT
Québec

88-04922/

CENTRE DE RECHERCHES MINÉRALES

1986 - 1987
ANNUAL REPORT

Cover Illustration: photomicrograph (viewed in light transmitted through a thin section) of a pyrigarnite from the Schefferville area.

Published by

le Centre de recherche minérales
Ministère de l'Energie et des Ressources
2700, rue Einstein
SAINTE-FOY (Québec)
G1P 3W8

Copyright: 3rd Quarter 1987
Bibliothèque nationale du Québec

ISBN 2-550-17929-3

THE CENTRE DE RECHERCHES MINÉRALES (CRM)

The Mines Branch of the Ministry of Energy and Resources has as an overall mandate to assure the management and development of the mineral industry in Québec. The role played by CRM in the achievement of Ministry objectives falls under scientific and technical assistance offered to mining companies in the search for solutions to their day to day problems.

The subject areas of CRM involvement can be broadly classed into three categories; mineral analysis, metallurgical research (in the laboratory and the pilot plant), and mining technology.

The offices and laboratories of the Centre de recherches minérales are located in the "Complexe scientifique du Québec", in Sainte-Foy, at the following address;

Centre de recherches minérales
Complexe scientifique du Québec
2700, rue Einstein
SAINTE-FOY (Québec)
G1P 3W8

Tel: (418) 643-4540
FAX: (418) 643-6706

The pilot plant is located at the St-Malo Industrial Park;

Centre de recherches minérales
Pilot Plant
1180, Place Dufresne
QUEBEC (Québec)
G1N 1X7

Tel: (418) 643-9602
FAX: (418) 643-9307

MESSAGE FROM THE DIRECTOR GENERAL

The Centre de recherches minérales (CRM) has continued in the steadfast pursuit of its activities this year, consistent with the objectives established in its 1985-88 three-year plan. Inspired by these goals, CRM has successfully increased its participation in research directed to finding practical solutions to problems faced by the mineral industry. The principal sectors of activity at CRM are: mineral processing both in the laboratory and in the pilot plant; analysis and analytical research; computerized instrumentation; applied mineralogy; and the various domains of applied technology for mining exploration.

As expected, CRM has been less active in the area of routine chemical analyses provided to meet the needs of external clients. Nonetheless, it has consolidated its position with respect to the more complex analyses requiring sophisticated instrumentation and expertise such as is rarely found in private laboratories.

On the other hand, our statistics covering analytical research indicate a net progression in this area as compared to last year. Funded projects undertaken for the direct benefit of companies have increased more than 85% with respect to 1985-86. This increase is clearly visible in the three sectors of the mineral analysis section; namely, analytical research, computers and instrumentation, and applied mineralogy.

In mining technology, CRM has achieved some marked advances over previous years. The objectives established for the present year have also been reached and even surpassed, in particular, with respect to the time devoted to funded projects.

Through its Mining Technology Section (STM), CRM has paid particular attention to technology transfer. In collaboration with various associations, three major symposia were organized by STM to disseminate and share the knowledge acquired by CRM researchers with participants from the mining sector, especially those from the Abitibi-Témiscamingue region.

During the year, all the employees of CRM, in particular the management and research staff, were called upon to promote research and development among the mining companies. They dedicated themselves to demonstrating that profits can be increased through research. Through the industrial development agent and the professionals/researchers, numerous visits were made to directors and representatives of companies within the mineral sector, to examine with them various means of improving the performance of their companies, or of developing new products. Particular emphasis was placed on the dissemination of knowledge through various means, such as conferences, scientific publications, and above all, through seminars and colloquiums which addressed recent developments in the specific areas of concern to the companies.

CRM has always operated under the firm belief that research constitutes an activity fundamental to the success of a company. So that this premise might be confirmed, an independent private firm was asked to verify the impact of several projects undertaken during the last five years. The results of this study clearly demonstrate that the practical application of the

conclusions reached by some projects leads to significant real benefits to the firms involved, while some other projects, without any direct impact, serve to enlighten the decision-making process and, consequently, contribute to planning with confidence.

The year 1986-87 was particularly busy in metallurgical research, both in the laboratory and at the pilot plant. In fact, it was an excellent year when one considers both the unprecedented volume of activities undertaken and paid for by private companies, and the size of the problems and their difficulty.

I should point out the value of the projects undertaken in the pilot plant, which surpassed the $1.5 million mark. This plant, unique to Québec, has the necessary flexibility to be applied to all manner of requests for service, whatever their nature, whether grinding, flotation, cyanidation, pelletizing, or leaching. Also noteworthy is the involvement of CRM in the sector of iron ore processing and beneficiation, where work valued at about $1.5 million was undertaken. Finally, because of the intense activity persisting throughout the year in the gold sector, CRM undertook for several companies more than 30 paid research projects with a total value of close to $1 million.

As you read further in this document, you will begin to appreciate the extent of CRM accomplishments during the year 1986-87. You will find that these accomplishments are the result of the combined efforts of all the employees of the centre, without specific mention of any. For this reason, I would like to publicly thank the employees of CRM for their contributions to the development and support of the Québec mineral industry.

Gérard Castonguay
Deputy Director-General

TABLE OF CONTENTS

MESSAGE FROM THE DIRECTOR GENERAL iii

TABLE OF CONTENTS viii

LIST OF TABLES AND FIGURES x

INTRODUCTION 1

MINERAL ANALYSIS DIVISION 2

- General Objectives 2
- Personnel and Resources 3
- Major Accomplishments 3
- Mineral Analysis 4
- Analytical Research 8
- Research in Computerized Instrumentation 14
- Research in Applied Mineralogy 17
- Objectives for 1987-88 25

METALLURGICAL RESEARCH DIVISION 26

- General Objectives 26
- Personnel and Resources 28
- Results 31
- Objectives for 1987-88 75

MINING TECHNOLOGY SECTION 77

- General Objectives 77

- Personnel and Resources 78

- Summary of Activities 79

- Major Accomplishments 80

- Difficulties Encountered 81

- Objectives for 1987-88 82

ADMINISTRATION AND MARKETING DIVISION 89

- General Objectives 89

- Personnel and Resources 90

- Summary of Activities 91

- Objectives for 1987-88 94

PRESENTATIONS AT CONGRESSES AND CONFERENCES 95

PUBLICATIONS BY CRM PERSONNEL 96

EXTERNAL ACTIVITIES OF CRM PERSONNEL 97

MEMBERS OF THE CRM ADVISORY COMMITTEE 100

MEMBERS OF THE ADVISORY COMMITTEE
FOR THE CRM MINING TECHNOLOGY SECTION 101

CRM PERSONNEL 103

LIST OF TABLES AND FIGURES

MINERAL ANALYSIS DIVISION (DAM)

Page

FIGURE 1 - Distribution of Analytical Activity by Client 6

TABLE 1 - Analytical Contracts Awarded to External Organizations 7

TABLE 2 - Research Activities by Sub-Activity and Project Type 24

TABLE 3 - Production Objectives for 1986-87 and Actual Situation on March 31, 1987 27

METALLURGICAL RESEARCH DIVISION (DRM)

TABLE 4 - Metallurgical Research Division Personnel 1986-87. 29

TABLE 5 - Activities of DRM Personnel in 1986-87 30

TABLE 6 - DRM Projects by Type 1986-87 32

TABLE 7 - Distribution of DRM Resources by Activity Sector.. 33

TABLE 8 - Type of Projects in DRM by Activity Sector 34

TABLE 9 - Value of Projects 36

TABLE 10 - DRM Resources by Administrative Region of Québec.. 37

TABLE 11 - Funded Activities 39

TABLE 12 - Order Sheets as of March 31, 1987 40

TABLE 13 - DRM Clients in 1986-87 - New Contracts 42

TABLE 14 - Pilot Projects 44

TABLE 15 - Internal Projects and Research Contracts 45

TABLE 16 - Research Contracts Awarded to External Organizations 47

TABLE 17 - Projects - Industrial Minerals 49

TABLE 18 - Projects - Precious Metal Ores 55

TABLE 19 - Projects - Iron Ore 60

TABLE 20 - Projects - Non-ferrous Metal Ores 63

TABLE 21 - Projects - Niobium and Other Metallic Ores 67

TABLE 22 - Projects - Control of Mineralogical Processes 71

TABLE 23 - Projects - Miscellaneous 73

MINING TECHNOLOGY SECTION (STM)

TABLE 24 - STM Operating Budget 84

TABLE 25 - Distribution of Projects by Value 85

TABLE 26 - STM Clients in 1986-87 86

TABLE 27 - Distribution of STM Clients by Region 87

TABLE 28 - Research Contracts 88

ADMINISTRATION AND MARKETING SECTION

TABLE 29 - Expenditures of the
Administration and Marketing Section in 1986-87.. 90

TABLE 30 - CRM Expenditures and Revenues in 1986-87 92

INTRODUCTION

At the end of each year, companies customarily produce a retrospective of past activities so as to compare performance with previous years and, if possible, to derive information which may be used to better direct future activities. At CRM, this self-appraisal takes the form of an annual report, presenting an overview of the accomplishments of each section within the Centre.

In light of the information contained within this document on each completed project, you will better appreciate the ability of CRM to provide concrete assistance in your own domain of activity. Of course, you may not find detailed information concerning each of these projects because, in any research undertaken with a client, CRM agrees to keep research results confidential. Finally, you will come to know the employees of CRM, to discover their specialty areas, and to be in a position to interact with them more effectively in the search for solutions to your problems.

MINERAL ANALYSIS DIVISION
Marc Pichette, director

Head of Chemical Section
Jean Guimont

Head of Mineralogical Section
Simon Turmel

GENERAL OBJECTIVES

The Mineral Analysis Division (DAM) provides analytical and research services to groups within the Mines Branch of the Ministry of Energy and Resources (MER), and to various groups within the mineral industry, wherever their activities touch upon the discovery, extraction, beneficiation, and use of Québec's mineral wealth. The activity of mineral analysis exists above all to respond to requests from scientists in the Metallurgical Research Division (DRM) within CRM, and in the Geological and Mineral Exploration Division (DGEGM) of MER. Analytical services are also made available to prospectors, mining companies, and to public and parapublic organizations in order to satisfy certain requirements under the Mining Act (analysis certificates) and for complex analyses or those requiring precise results.

The Mineral Analysis Division also undertakes funded projects for groups involved in mineral and analytical research, computerized instrumentation, and applied mineralogy. In finding solutions to such problems, DAM contributes to evaluating the mineral potential of mining deposits, and to increasing the productivity and competitive strength of companies.

PERSONNEL AND RESOURCES

The Mineral Analysis Division is made up of the Chemical Section, and the Physics/Mineralogy Section. On March 31, 1987, the division had 43 full-time and 5 part-time employees, for a total of 48 people, including 3 managers, 11 professionals, 3 secretaries, and 31 technicians and tradesmen.

The operating budget, including $300,000 provided through the 10-01 program, was $2,766,800, divided into $1,565,800 for the Chemical Section, $931,500 for the Physical/Mineralogical Section, and $269,500 representing the division's contribution to the Administration and Marketing Section of CRM.

The acquisition, in December 1986, of a sequentially reading atomic emission plasma spectrometer (SEAP) with a value of $175,000 was a major capital investment for DAM. The cost of installation and optimization of this computerized analytical system is to be spread out over several years. Its use will address various needs of our industrial clientèle, and it will specifically be useful in the improvement and development of analytical methods leading to productivity improvements, training of SEAP personnel, analysis of particularly difficult samples, reduction of analytical expenses, and optimization of certain parameters leading to more efficient analytical methods.

MAJOR ACCOMPLISHMENTS

In 1986-87, more than 500,000 analyses were completed at a cost of $1,358,417.

Industrial and internal clients took advantage of new mineralogical services indispensable to the development and improvement of processing methods and the evaluation of mining deposits, thanks to the installation of a scanning electron microscope connected to an image processing unit, recently acquired at a cost of $500,000.

The application of computerized instrumentation and the development of suitable analytical methods contributed to improving the efficiency of available analytical services.

A neutron activation analysis laboratory was opened with the collaboration of INRS-Géoressources. This equipment allows various elements of interest to Ministry geologists to be detected with great precision, lowers the limits of detectability, and reduces analytical costs for several elements.

Ninety-seven (97) research projects were completed at a cost of $555,787. Fifty-nine (59) of these were undertaken with the financial participation of the mineral industry. These projects involved analytical research, computerized instrumentation, and applied mineralogy.

MINERAL ANALYSIS

During 1986-87, 39,496 samples were analysed, involving 509,005 determinations in a wide variety of substances: ores, minerals, rocks, sediments, soils, mine tailings, drill cores, alloys, processed substances, and products of leaching. The concentration of detected elements varied from a few parts per billion (ppb) to close to 100%. Both the variety of samples and

the wide range of concentrations encountered necessitated the use of several of the most modern analytical techniques. The quality of results was assured by the competence of our personnel specialized in mineral analysis, and by quality control checks made throughout the testing. The analytical work undertaken for various client groups is summarized in Figure 1.

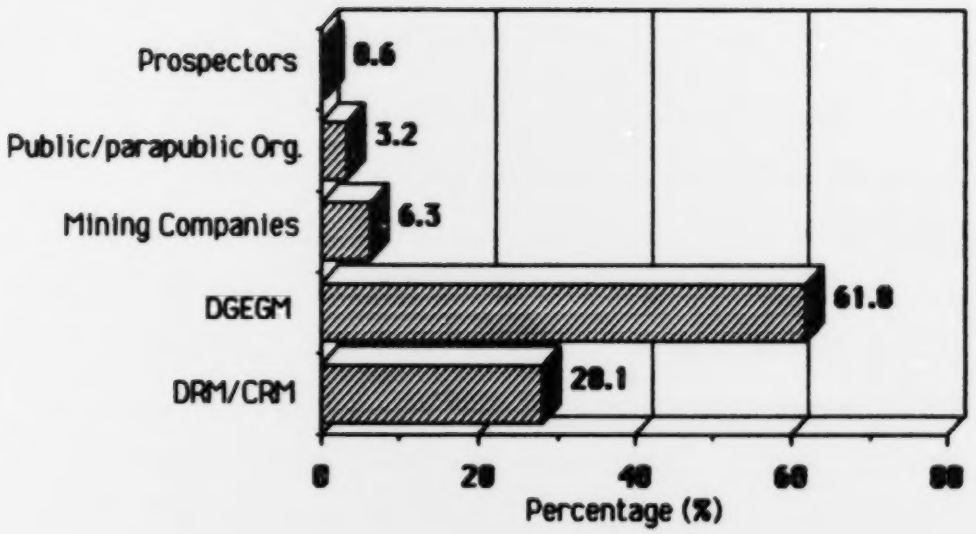
The greatest part of these efforts (61.8%) was done for the Geological and Mineral Exploration Division (DGEGM) of MER in their studies directed to gathering geological information and establishing the mineral potential of Québec.

DAM also supplied all the analytical support necessary to the activities of the Metallurgical Research Division (DRM) of CRM, participating in 127 of its mineralogical and metallurgical process development projects with companies in the Québec mineral industry. In total, 16,600 samples were analyzed for DRM, representing 49,442 determinations at a cost of $380,611, or 28.1% of the total analytical activities. Examples include Project 2426 (A pilot process to decrease Mn in concentrates) for Wabush Mines, which involved 7809 determinations at a cost of $71,508; Project 2521 (Cyanidation tests on Casa Berardi gold ore) for INCO, where 1844 determinations totalled $28,395; and Project 2458 (Parameters for gold ore processing, Project Astoria) for Ressources Yorbeau Inc. involving 2317 determinations at a cost of $24,864.

FIGURE 1

Analytical Activity by Client

1986-87



Companies involved in mining exploration, mine development, and mineral beneficiation benefitted from 6.3% of the analytical efforts, while the remaining efforts were directed to public and parapublic organizations (3.2%), and to prospectors (0.6%). A total of $39,746 was used to grant various analytical contracts during 1986-87. Statistics relative to these contracts appear in Table 1.

TABLE 1

Analysis Contracts Awarded to External Laboratories

1986-87

LABORATORY	SAMPLES	ANALYSES	COST ($)
Chimitec Ltée	700	700	4,725
Ecole Polytechnique	137	559	7,035
INRS-Géoressources	215	322	7,976
Laval University	1	7	300
McMaster University	219	-	19,710
TOTAL	1,272	1,588	39,746

These contracts were intended to fill certain specific needs such as the irradiation of samples for neutron activation analysis, and the detection of certain rare earths by neutron activation and of gold, arsenic, and antimony at the part per trillion (ppt) level in water.

ANALYTICAL RESEARCH

During 1986-87, 26 analytical research projects were undertaken for a total of $196,637. Twelve (12) of these projects worth $83,412 were funded, and used to solve various analytical problems submitted by companies. There were four (4) training courses offered to selected CRM personnel on specialized analytical techniques. Three analytical methods were verified so as to select a reliable and accurate method for the routine detection of palladium and platinum in copper. An analytical procedure was developed to enhance the capabilities of a commercial laboratory, and another was developed to be used to confirm the exact platinum concentration in electrolysis slimes.

Fourteen (14) projects with a total value of $113,423 were completed to satisfy internal needs with the aim of improving the quality of services offered to customers while lowering the cost of operations.

Two (2) publications on analytical methods were prepared in 1986-87, and made available to mining company analytical laboratories and private laboratories in Québec. The first ('Methods for precious metal detection in mineral substances', R. Brindamour and R. Le Houillier, 1986) describes analytical

methods used in our laboratories for precious metal detection. In general, these are known methods which have been improved or adapted to detect certain precious metals in the wide variety of samples encountered by the mineral sector. These methods are used in our laboratories to analyze rocks, ores, concentrates, liquors, and metallurgical processing products in meeting the needs of CRM clients. The second publication ('Methods of detecting various mineral substances by atomic absorption spectrometry and by atomic emission plasma spectrometry', R. Gagné and J. Guimont, 1985-86) covers methods used in the Plasma Division of our Chemistry Section. This work addresses trace element detection methods and, in particular, the improvement and adaptation of known methods for analyzing sediments, rocks, and water.

A colloquium on 'The application of atomic emission plasma spectrometry to mineral analysis' was organized by CRM on October 21-22, 1986. The first day brought more than 70 people to a Sainte-Foy hotel, of which the majority were industrial representatives. This colloquium served to identify problems and to propose solutions to users of atomic emission plasma spectrometry. It also served to establish close ties between industry specialists and those of CRM. The second day was spent visiting our laboratories at the Complexe scientifique. Mr. Carol De Blois, the principal organizer of this colloquium, deserves credit for having made this event so successful, in bringing together prestigious speakers and industrial representatives interested in the analytical potential of this method.

The establishment of our neutron activation laboratory involved awarding three research projects worth $13,500 to INRS-Géoressources. Through these projects, and their expertise in the area, we were able to get our laboratory operational in the most efficient and cost-effective manner.

ANALYTICAL RESEARCH PROJECTS

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
	FUNDED PROJECTS		
Analysis of filtration products and of a deposit April, 1986	Hotel-Dieu de Lévis	362	R. Le Houillier
Verification of three analytical methods for platinum and palladium in samples of a copper anode May, 1986	Noranda Mines Ltd. Horne Division	21,715	R. Le Houillier C. De Blois
Niobium analysis by X-ray fluorescence: comparing fusion and non-fusion preparation, July 1986	Les Services TMG Inc. (Niobec)	1,707	J. Boivin J. Tremblay
Detection of sulphates, sulphides, thiosulphates, and di-thionates in iron concentrate leaching solutions, using ionic chromatography. Aug, 1986	DRM/CRM (2426) J.J. Panneton	17,333	C. De Blois A. Tremblay
Reactivity of reduced pellets and micro-structure. October, 1986	DRM/CRM (2464) I. Malinsky	7,351	R. Le Houillier
Platinum determination in slimes by fire assay and/or AAS. October, 1986	Kidd Creek Mines Ltd.	15,124	R. Le Houillier C. Tremblay
Training course in fire assay, November, 1986	Kidd Creek Mines Ltd.	2,166	R. Le Houillier

ANALYTICAL RESEARCH PROJECTS (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Tests to detect the oxidation state of nickel on asbestos fibres December, 1986	University of Sherbrooke	1,783	C. De Blois R. Le Houillier
Training course in fire assay. December, 1986	Noranda Mines Ltd.	1,964	R. Le Houillier
Analysis of the major and minor constituents of rocks using the ICAP-1100 atomic emission plasma spectrometer February, 1987	Chimitec Ltd	11,392	C. De Blois A. Tremblay
Trainee education in precious metal analysis using AAS. February, 1987	Recyclages Multimet Inc.	1,925	R. Le Houillier
Technical training March 1987	Atlas Steel	275	J. Boivin
	INTERNAL PROJECTS		
Tellurium detection by AAS April, 1986	DRM/CRM	12,002	R. Le Houillier
Rapid, semi-quantitative analysis using X-ray spectrometry, May, 1986	DG/CRM	7,559	J. Boivin
VGA quartz cell lifetime markedly increased by drierite, July 1986	DG/CRM	3,025	R. Le Houillier

ANALYTICAL RESEARCH PROJECTS (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Methods of detecting precious metals in liquids, rocks, and ores. July, 1986	DG/CRM	8,402	R. Le Houillier R. Brindamour
Methods of detecting trace elements in sediments, rocks, and water. October, 1986	DG/CRM	3,904	R. Gagné
ICP/AES and AAS : A difficult choice? November, 1986	DG/CRM	5,406	C. De Blois
Recovery of sulphurous grains following precious metal amalgamation. November, 1986	DG/CRM	1,595	R. Le Houillier
Maintenance and upgrading software to transmit X-ray fluorescence data to the Analytical Data Management System (SGDA). November, 1986	DG/CRM	1,351	J. Boivin J. Tremblay
Neutron Activation - an analytical method. Dec, 1986	DG/CRM	22,437	J. Boivin J. Tremblay
Pilot study on the detection of ultra-trace levels of platinum. January, 1987	DG/CRM	1,925	R. Le Houillier
Commissioning the ARL 8420+ spectrometer. January, 1987	DG/CRM	14,838	J. Boivin
Maintenance of the neutron activation laboratory. March, 1987	DG/CRM	1,952	J. Boivin
Continuous detection of mercury by atomic absorption spectrometry in a cold vapour March 1987	DG/CRM	16,878	C. De Blois
Atomic emission plasma spectrometry applied to mineral analysis. March 1987	DG/CRM	12,089	C. De Blois

RESEARCH IN COMPUTERIZED INSTRUMENTATION

In the area of computerized instrumentation, 18 projects were completed for a total of $136,447. Four of these were funded projects worth a total of $31,933.

Project 86-Ii-003, undertaken for the Québec-Cartier mining company, through DRM, consisted of gathering data on more than 70 transducers, to be used for control simulation. This will allow modelling some of the plant operations.

This sector was asked to contribute to supplying the technical support necessary for scientists within other administrative groups at CRM, both at the pilot plant, and in the main CRM laboratories located in the Complexe scientifique.

Many internal projects were completed, particularly for the atomic absorption division and the neutron activation laboratory with the aim of improving productivity through the use of computers.

RESEARCH PROJECTS IN COMPUTERIZED INSTRUMENTATION

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
	FUNDED PROJECTS		
Automatic acquisition of inclinometer data September, 1986	J.M.Asbestos Inc.	6,748	L.Barrette J.G.Chartrand R. Morasse
Data acquisition for the Québec-Cartier mining company, December, 1986	DRM/CRM (2441) S. Caron	22,358	L.Barrette J.G.Chartrand R. Morasse
Training in C^{14} dating March, 1987	Centre d'études nordiques	1,470	L.Barrette
Inclinometer data - Automatic data acquisition March, 1987	J.M.Asbestos Inc.	1,357	L.Barrette J.G.Chartrand
	INTERNAL PROJECTS		
Automating the weighing procedure on the Toledo balances in the pilot plant June, 1986	DRM/CRM	3,233	L.Barrette R. Morasse
Metallurgical balance sheets at LRM, August 1986	DRM/CRM	10,727	L.Barrette R. Morasse
Interfacing a neutron activation balance September, 1986	DG/CRM	1,415	L.Barrette R. Morasse
Conference chairman, September, 1986	DG/CRM	1,064	L.Barrette
Data acquisition system October, 1986	DG/CRM	3,920	L.Barrette J.G.Chartrand R. Morasse

RESEARCH PROJECTS IN COMPUTERIZED INSTRUMENTATION (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Mass measurements for a neutron activation monitor. October, 1986	DG/CRM	1,384	L.Barrette J.G.Chartrand R. Morasse
Reducibility of iron ore pellets in the pilot plant November, 1986	DRM/CRM	1,101	L.Barrette J.G.Chartrand
Technical services at the pilot plant, March, 1986	DRM/CRM	5,647	L.Barrette
Technical services for the metallurgical research lab March, 1986	DRM/CRM	4,792	L.Barrette
Technical services for the mineral analysis division March, 1986	DG/CRM	17,903	L.Barrette
Technical services for the mining technology section March, 1986	STM/CRM	7,054	L.Barrette
Computers in atomic absorption March, 1986	DG/CRM	34,201	L.Barrette J.G.Chartrand R.Morasse
Automatic remote data acquisition by direct link or by telephone, March 1986	STM/CRM	6,932	L.Barrette J.G.Chartrand R.Morasse
Commercial activities	DG/CRM	5,141	L.Barrette

RESEARCH IN APPLIED MINERALOGY

Fifty-three (53) research projects in applied mineralogy, representing a total of $222,703 were completed during 1986-87. This sector is in a growth phase, as can be seen by the increase in the number of projects which have been undertaken in recent years. The continued growth in the number of projects funded by mining companies is indicative of the interest they have in this area of activity.

Forty-eight (48) research projects for a total of $167,588 were completed with financial participation from companies, which represents 75.3% of the total activities in this sector.

The vast majority of this work was associated with gold, and served to determine which type of metallurgical tests to ask for, to better understand the metallogeny, to aid in the interpretation of the size of deposits and, finally, to better know the composition and texture of various ores.

One internal project for DRM was completed, as were four (4) others for the direct use of the applied mineralogy division. The latter projects essentially dealt with image processing.

A colloquium on "Applied Mineralogy: a source of profits for the mining industry" was organized by CRM. Taking place in Val d'Or on March 26, 1987, it brought together more than sixty (60) participants with interests in both exploration and mining operations. The meeting was a great success, as judged by the attendees, thanks especially to the main organizer, Mr. Jean-

François Wilhelmy, who was able to bring together quality speakers who clearly demonstrated how applied mineralogy can be profitable to various stages of mining operations.

A research project in applied mineralogy was granted to McGill University. This project, worth $27,960, is related to image processing, and seeks to accelerate development in this sector so that we are able to supply the services expected by our industrial clientèle.

RESEARCH PROJECTS IN APPLIED MINERALOGY

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
	FUNDED PROJECTS		
Characterization of two abrasive molds, April, 1986	DRM/CRM (2431) M. Thérien	1,308	J.F.Wilhelmy
Evaluation of contamination due to coal ash April, 1986	Wabush Mines	1,048	J.F.Wilhelmy
Mineralography of gold in a composite of tailings April, 1986	Lac Minerals Ltd	3,135	J.F.Wilhelmy
Slag composition May, 1986	DRM/CRM (2435) M. Thérien	1,639	J.F.Wilhelmy
Textural comparison of three types of iron pellets, May, 1986	DRM/CRM (2428) G.Paquet	1,476	B.Kieller
Mineralogical study of limestone, May 1986	Jolichaux Inc.	1,150	G. Gauthier

RESEARCH PROJECTS IN APPLIED MINERALOGY (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Detecting gold in cyanidation wastes from Telbel mine May, 1986	DRM/CRM (2348) R. Tremblay	2,608	G.Gauthier
Petrographic study of eleven samples from the North-West region, May, 1986	College of Abitibi-Témiscamingue	2,218	B.Kieller
Mineralogical study of cyanidation residues after bacterial leaching May, 1986	DRM/CRM (2429) R. Tremblay	4,125	G.Gauthier
Detecting titanium in a pyrochloric concentrate May 1986	DRM/CRM (2357) G. Delisle	1,151	J.F.Wilhelmy
Study of the mineralogical transformation of the Seleine mine. May, 1986	SOQUEM	1,377	J.F.Wilhelmy
Study of the gold-bearing mineralization of a syenite June, 1986	Ressources Aiguebelle Inc.	3,944	J.F.Wilhelmy
Mineralography of gold in cyanidation wastes June, 1986	Agnico Eagle Mines Ltd.	1,706	J.F.Wilhelmy
Study of an ore sample from the Selbaie mine June, 1986	Mines Selbaie	2,122	J.F.Wilhelmy
Mineralography of gold in the Astoria deposit (Zone B) July, 1986	DRM/CRM G. Delisle	5,727	J.F.Wilhelmy
Mineralography of ten samples of reduced iron pellets June, 1986	DRM/CRM (2370) I. Malinsky	4,703	B.Kieller

RESEARCH PROJECTS IN APPLIED MINERALOGY (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Pyrite characterization in two samples of coal and coke July, 1986	Canada Lafarge Cement Ltd.	958	J.F.Wilhelmy
Mineralogy and texture of pellets before and after reduction. July, 1986	DRM/CRM (2470) I. Malinsky	2,561	J.F.Wilhelmy
Study of the degree of liberation in sample 5377 July, 1986	Agnico Eagle Mines Inc. (Gold Division)	1,077	J.F.Wilhelmy
Mineralogy and texture of four iron pellet samples (pot grade: 0.4% coke) July, 1986	DRM/CRM (2464) I. Malinsky	1,448	J.F.Wilhelmy
Evaluation of the economic potential of a carbonite August, 1986	Falconbridge Copper Corp.	6,643	B.Kieller J.F.Wilhelmy
Mineralogical determination on a gravimetric concentrate August, 1986	McGill University	857	J.F.Wilhelmy
Petrographic description of two gold-bearing samples from the Schefferville region August, 1986	DGEGM	2,572	B.Kieller J.F.Wilhelmy
Mineralogical study of sixteen samples from the Chibougamau-Chapais-Desmarais region September, 1986	DGEGM	11,149	B.Kieller J.F.Wilhelmy J.Cantin D.Moisan
Petrographic description of eighteen gold-bearing samples September, 1986	Exploration Vior Inc	4,216	B.Kieller J.F.Wilhelmy
Mineralogical characterization of a granite gneiss September, 1986	STM (680) C. Morin	1,000	B.Kieller J.F.Wilhelmy G.Gauthier
Mineralogical study of fifteen samples from Niobec mine October, 1986	Mine Niobec	12,118	B.Kieller J.F.Wilhelmy

RESEARCH PROJECTS IN APPLIED MINERALOGY (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Mineralogical determination of a compound of Bousquet ore, Dumagami extension October, 1986	Minerais Lac Ltée	2,874	J.F.Wilhelmy
Petrographic description of four rock samples from the Montréal region. October, 1986	DGEGM	1,695	J.F.Wilhelmy
The nature of arsenic and zinc compounds in twelve sediment samples. October, 1986	DGEGM	4,294	B.Kieller J.F.Wilhelmy
Petrography of fourteen samples from Souart township November, 1986	Geologica Inc	5,428	B.Kieller J.F.Wilhelmy
Mineralography of gold in two samples from the Lac Bachelor gold mine. November, 1986	DRM/CRM (2503) G. Delisle	3,930	B.Kieller J.F.Wilhelmy
Mineralogical characterization and study of rust coloration in three samples of granite gneiss November, 1986	STM/CRM (680) C. Morin	2,583	B.Kieller J.F.Wilhelmy
Study of ore from the Lac Bachelor gold mine November, 1986	Lac Bachelor	883	B.Kieller J.F.Wilhelmy
Mineralography of gold in flotation wastes. November, 1986	Agnico Eagle Mines Inc	1,101	B.Kieller J.F.Wilhelmy
Mineralogy of six samples of gold-bearing pyrite December, 1986	DRM/CRM (2508) J. Dionne	3,575	B.Kieller J.F.Wilhelmy
Study of three processing samples from the Northgate-Patino mine December, 1986	DRM/CRM (2506) G. Delisle	5,141	B.Kieller J.F.Wilhelmy
Detailed mineralogical study of five samples from the Seleine mine. December, 1986	DRM/CRM (2512) G. Delisle	4,799	B.Kieller J.F.Wilhelmy

RESEARCH PROJECTS IN APPLIED MINERALOGY (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
Mineralography of a sample from the Grand Calumet area January, 1987	DGEGM	1,593	B.Kieller J.F.Wilhelmy
Mineralogy of titanium in a schist. January, 1987	SOQUEM	1,192	J.F.Wilhelmy
Morphological study of free gold in eight concentrates January, 1987	DRM/CRM (2521) R. Tremblay	1,586	B.Kieller
Mineralogy of a copper and nickel ore from the Ivory Coast. February, 1987	DRM/CRM (2519) M. Thérien	7,584	B.Kieller J.F.Wilhelmy
Study of gold liberation in three process samples February, 1987	Mines Camchib Inc	10,622	B.Kieller J.F.Wilhelmy
Mineralography of gold in wastes from analyses. February, 1987	Cambior Inc	3,111	J.F.Wilhelmy
Characterization of various synthetic inorganic compounds March, 1987	IGM	2,832	J.F.Wilhelmy
Petrography and mineralography of the Marcor zone. March, 1987	Exploration Muscocho ltée	7,790	B.Kieller J.F.Wilhelmy
Mineralography of gold in two ores from Souart township March, 1987	Ressources Oasis Inc.	8,517	B.Kieller J.F.Wilhelmy
Mineralography of cobalt and molybdenum in mine wastes March, 1987	Recbiomine Inc	2,364	B.Kieller J.F.Wilhelmy

RESEARCH PROJECTS IN APPLIED MINERALOGY (cont')

TITLE AND DATE	CLIENT	COST ($)	REPORT AUTHORS
	INTERNAL PROJECTS		
Familiarization study on the electron microscope coupled with an image processor May, 1986	DG/CRM	18,466	J.Boivin J.F.Wilhelmy
Familiarization with microanalysis. December, 1986	DG/CRM	5,805	J.Boivin
Effect of temperature on the distillation of mercury containing gold. February, 1987	DG/CRM	1,408	J.F.Wilhelmy
Familiarization with image processing. March, 1987	DG/CRM	19,875	J.F.Wilhelmy
Reference intensities for X-ray diffraction. March, 1987	DG/CRM	9,561	B.Kieller J.F.Wilhelmy

In total, 97 research projects were completed in 1986-87, with a total value of $555,787. The difference with respect to the previous year can be explained by the decrease in human resources directed to research and by an accounting method which includes data on projects which are entirely completed before March 31. Research efforts by client and by sub-activity are shown in Table 2, and compared to the previous year.

TABLE 2

Research Projects by Sub-Activity and Project Type

TYPE OF PROJECT	SUB-ACTIVITY	NUMBER OF REPORTS		COST ($)	
		1985-86	1986-87	1985-86	1986-87
FUNDED	-ANALYTICAL RESEARCH	7	12	19,016	83,214
	-RESEARCH IN COMPUTER INSTRUMENTATION	3	4	15,707	31,933
	-RESEARCH IN APPLIED MINERALOGY	33	48	117,895	167,588
	SUB-TOTAL	43	64	152,618	282,735
INTERNAL DRM-STM/CRM	-ANALYTICAL RESEARCH	4	1	75,419	12,062
	-RESEARCH IN COMPUTER INSTRUMENTATION	3	7	44,033	39,486
	-RESEARCH IN APPLIED MINERALOGY	-	1	-	1,408
	SUB-TOTAL	7	9	119,452	52,956
INTERNAL DG/CRM	-ANALYTICAL RESEARCH	17	13	284,563	101,361
	-RESEARCH IN COMPUTER INSTRUMENTATION	7	7	108,007	65,028
	-RESEARCH IN APPLIED MINERALOGY	5	4	54,152	53,707
	SUB-TOTAL	29	24	446,772	220,096
TOTAL	-ANALYTICAL RESEARCH	28	26	378,998	196,637
	-RESEARCH IN COMPUTER INSTRUMENTATION	13	18	167,747	136,447
	-RESEARCH IN APPLIED MINERALOGY	38	53	172,047	222,703
	GRAND TOTAL	79	97	718,792	555,787

OBJECTIVES FOR 1987-88

In 1987-88, 68% of DAM credits will be used to finance analytical activities. The breakdown of analytical efforts by client group should be; MER Geological and Mineral Exploration Division (71%), CRM Metallurgical Division (24%), mining companies, prospectors, public and parapublic organizations (5%). Analytical services available to clients external to CRM will be billed at 100% of operating costs.

Analytical research will, for its part, account for 10% of the total credits, computerized instrumentation will total 9%, and applied mineralogy, 13%.

Work carried out with the financial participation of companies will be emphasized, and a significant increase in the number of funded projects is anticipated. Such company-funded research projects will be billed at 40% of operating costs, as compared to 30% in the previous year.

Internally, significant efforts are planned to optimize the electron microscope and image processing system in order to respond to requests from the mineral sector. In analytical research, the principal internal efforts will concern the development of methods for DRM use, as well as the development of platinoid detection methods for use in geological and geochemical prospecting.

A colloquium on X-ray diffraction will be organized during 1987-88.

METALLURGICAL RESEARCH DIVISION
Alain Claveau, director

Metallurgical Research Laboratory Section
Jean Gobeil, head

Pilot Plant Section
Gontran Foy, head

GENERAL OBJECTIVES

The Metallurgical Research Division (DRM) of the Centre de recherche minérales (CRM) contributes to the economic development of the mineral sector by undertaking, with industrial collaboration, studies and trials, bench tests, and pilot scale testing, with the aim of adapting, developing, or optimizing the primary processing and beneficiation processes of Québec mineral substances. These activities contribute to the establishment of new companies, to productivity improvements in existing plants, and to increasing the degree of beneficiation and expanding the uses of mineral substances extracted and processed in Québec.

The 1986-87 milestones of the Metallurgical Research Division established planning objectives in each of the principal activity sectors. These outlooks anticipated strong growth in funded activities as compared to previous years, as well as a marked improvement in controlling costs and meeting the completion dates of projects. Table 3 shows the objectives set at the beginning of the year and the results attained, for each of the principal production indices. Note that most of the objectives were met and surpassed, which speaks well for the success of DRM activities in 1986-87. The most revealing indicator is the value of funded projects completed, which

reached $2.72 million, or 4.8% more than the objective, which itself was almost 30% above the results of the two previous years. This production improvement was not achieved at the expense of quality, as many of the projects undertaken by DRM personnel produced very positive results, and several are likely to lead to short-term spinoffs.

TABLE 3

Production Objectives 1986-87

Actual Results as of March 31, 1987

	Objectives 1986-87	Results 31/3/87
1. Percentage of available hours directed to projects (%)	75.0	79.6
2. Percentage of funded projects (%)	72.0	70.1
3. Percentage of hours sold (%)	54.0	55.8
4. Value of funded projects ($'000)	2,600	2,725.7
5. Cost overruns (% of value)	7.0	4.7
6. On-time project completions (%)	75.0	72.5
7. Revenues ($'000)	700.0	720.9

PERSONNEL AND RESOURCES

During the past year, DRM had 60 permanent positions: 3 managers, 19 professionals, 23 technicians, 9 tradesmen, and 5 support staff employees. Two positions were left vacant at year's end. Including part-time personnel, 69.1 person-years contributed to DRM activities in 1986-87. A total of 51.1 person-years were involved in projects, or 74% of the total. Table 4 shows the 1986-87 distribution of various personnel categories between the two sections of DRM, as compared to predicted numbers.

Table 5 shows the principal activities of project personnel compared to the two previous years. There has been a substantial increase in external activities, representing 71.4% of the available personnel, while funded activities account for 55.9%.

The expenditures of DRM rose to $3.5 million, which is 8% less than the previous year. Moreover, analytical services and mineralogical studies with a value of $480,000 were supplied by the Mineral Analysis Division in the course of DRM projects.

As for equipment, the Metallurgical Research Laboratory Section (LRM) installed a fine particle classifier operating in the 0.5 to 100 micrometer range, opening new potential for studies of industrial mineral fine particle production. In the pilot plant, a carbon-in-pulp (CIP) gold extraction circuit was integrated into the cyanidation circuit. With the addition of a gold elution circuit, and of electrolysis tanks, the pilot plant is now equipped with a complete ore processing circuit at the leading edge of technology.

TABLE 4

Metallurgical Research Division Personnel

1986-87

		Predicted		Actual	
DRM Personnel	Managers	3		3	
	Secretaries	3 (1) §		3 (1.0) §	
	Sub-total	6		6	
		LRM	Pilot Plant	LRM	Pilot Plant
Project Personnel	Professionals	13 (1)	7	12.5 (1)	7.1
	Technicians	14	9 (1)	14.0	7.4
	Assistants	1	-	1.0	-
	Ore Processing personnel	-	1	-	1.0
	Workers	-	1	-	1.0
	Part-time	(1)	(3)	(2.5)	(4.6)
	Sub-total	29	21	30.0	21.1
Support Staff	Technicians	2	1	2	1
	Specialized workers	1	4	1	4
	Storekeeper	-	1	-	1
	Typists	1	1	1	1
	Drivers	-	1	-	1
	Sub-Total	4	8	4.0	8.0
	Total	33 (2)	29 (4)	34.0 (3.5)	29.1 (4.6)
Project Personnel		50.0 (6.0)		51.1 (7.1)	
Total Personnel		68.0 (8.0)		69.1 (9.1)	

Note § : Part-time personnel are shown in parentheses throughout

TABLE 5

Activities of DRM Personnel 1986-87

Number of Available Hours by Activity	1986-87 84146	1985-86 77589	1984-85 77673
	(%)	(%)	(%)
-External Activities	71.4	64.3	62.5
Funded projects	54.0	43.5	46.0
Standard determinations (funded)	1.9	4.0	3.9
Pilot projects and joint projects	3.0	5.9	3.9
Technical bulletins	5.7	3.4	2.3
Meetings with clients and preparation of work programs	3.7	4.2	3.4
Industrial visits, colloquiums and conferences	2.3	2.3	2.0
External collaboration	0.8	1.0	1.0
-Internal Activities	28.6	35.7	37.5
Internal and special projects	14.3	14.1	14.5
General research and technical documentation	4.9	7.4	7.0
Administration and training	4.2	7.4	6.3
Maintenance and experimental setups	5.1	6.8	9.7
Project activities (%)	79.6	71.5	71.5
External activities (%)	71.4	64.3	62.5
Time 'sold' (%)	55.9	47.5	49.9

RESULTS

-General

DRM personnel participated in 167 projects with a total value close to $4.3 million. While this is the same number of projects as in the previous year, their total value increased by 27.4%. This growth was particularly notable in the funded projects carried out for companies in the mineral sector. Tables 4 to 8 show the results of this latest year compared to those of previous years, arranged by project types, value of projects, sectors of activity, and regional distribution.

The following points are of interest:

- there was strong growth in the value of funded projects at the pilot plant. Project values exceeded $1.6 million, or 60% more than the previous year (Table 6);

- with the exception of pilot projects which fell slightly in number, every type of activity shows increases compared to the previous year (Table 6);

- activities in iron ore processing, gold ore processing, and industrial mineral processing accounted for more than 70% of the total activities (Table 7);

- iron ore processing projects represented the greatest fraction of DRM activities, with projects worth $1.47 million, an increase of 90% with respect to 1985-86 (Table 7 and Table 8);

TABLE 6

DRM Projects by Type

1986-87

		Funded Projects			Pilot Projects			Internal Projects and Contracts			Technical Bulletins & General Research		
		86-87	85-86	84-85	86-87	85-86	84-85	86-87	85-86	84-85	86-87	85-86	84-85
Laboratory	Number	67	67	55	9	14	17	34	30	37	-	-	-
	Value ('$000)	1073.6	1033.0	1885.4	43.4	60.8	79.5	642.4	616.0	496.3	299.0	190.2	134.1
Pilot Plant	Number	32	38	22	2	1	7	22	17	8	-	-	-
	Value ('$000)	1648.8	1022.4	1148.6	1.3	1.2	35.9	530.6	376.8	308.4	41.5	22.7	9.1
Total DRM	Number	99	105	77	11	15	24	56	47	45	-	-	-
	Value ('$000)	2721.6	2056.4	2034.0	44.7	62.0	115.4	1173.0	992.8	804.7	340.5	212.9	143.2

TABLE 7

Distribution of DRM Resources

By Activity Sector

	1986-87				1985-86			
	Number of Projects	Value ('$000)	Percent of Total	Percent Funded (%)	Number of Projects	Value ('$000)	Percent of Total	Percent Funded (%)
Processing & beneficiation of industrial minerals	53	562.0	13.1	59.8	54	665.7	19.8	74.7
Processing of precious metal ores	32	939.6	21.9	72.1	38	609.3	18.1	66.3
Processing & beneficiation of iron ore	21	1474.0	34.4	92.6	25	773.9	23.0	69.4
Processing & beneficiation of non-ferrous metal ore	14	249.1	5.8	43.7	17	145.9	4.3	55.9
Processing of niobium ore and other metals	11	209.0	4.9	64.8	9	559.3	16.6	88.7
Mineralogical process control	11	401.5	9.4	3.4	15	406.1	12.1	9.8
Miscellaneous	25	445.9	10.4	19.9	9	199.6	5.9	0.0
TOTAL	167	4281.1	100.0	63.7	167	3359.8	100.0	61.2

TABLE 8

Type of Projects in DRM

By Activity Sector

	Funded Projects ('$000)	Pilot Projects ('$000)	Internal Projects ('$000)	Technical Bulletins + Research ('$000)	Contracts ('$000)	------ TOTAL ------ Total ($'000)	85-86 Change (%)	Revenues ('$000)
Processing & beneficiation of industrial minerals	336.3	35.9	125.8	62.7	-	562.0	-15.6	76.7
Processing of precious metal ores	667.1	1.8	200.1	54.0	6.6	939.6	+54.2	197.7
Processing & beneficiation of iron ore	1365.5	-	40.1	25.0	43.4	1474.0	+90.5	365.9
Processing & beneficiation of non-ferrous metal ore	104.7	4.1	75.2	1.4	63.7	249.1	+70.7	24.1
Processing of niobium ore and other metals	135.4	2.9	20.5	6.5	43.7	209.0	-62.6	32.2
Mineralogical process control	13.7	-	215.6	16.2	156.0	401.5	- 1.1	0.0
Miscellaneous	88.9	-	182.3	174.7	-	445.9	+123.4	24.3
TOTAL	2721.6	44.7	859.6	340.5	313.4	4281.1	+27.4	720.9

- significant growth can also be observed in precious metal ore processing, for which projects worth $0.94 million were completed, an increase of 54% over the previous year (Table 8);

- a considerable drop in the niobium ore processing projects (-62%) can be attributed to the completion of work on the development of processing methods for the Crevier deposit (Table 8);

- the average value of projects grew to $21,700, but this average was inflated by a major project requiring expenditures of close to $700,000 (Table 9);

- very few funded projects were completed on the control of mineralogical processes, confirming our lack of success in penetrating this sector;

- fifty percent (50%) of DRM resources were directed to projects from the Cote-Nord (09) and Abitibi-Témiscamingue (08) regions; over 90% of these projects were funded (Table 10);

- nearly one-third (28.5%) of DRM resources were used for projects affecting all regions. For the most part, these were internal projects (Table 10).

TABLE 9

Value of Projects

	1986-87	1985-86
More than $100,000	4	4
$50,000 - $100,000	7	4
$20,000 - $50,000	27	22
$5,000 - $20,000	61	66
$1,000 - $5,000	56	59
Less than $1,000	12	12
Average Value	$21,700	$15,900

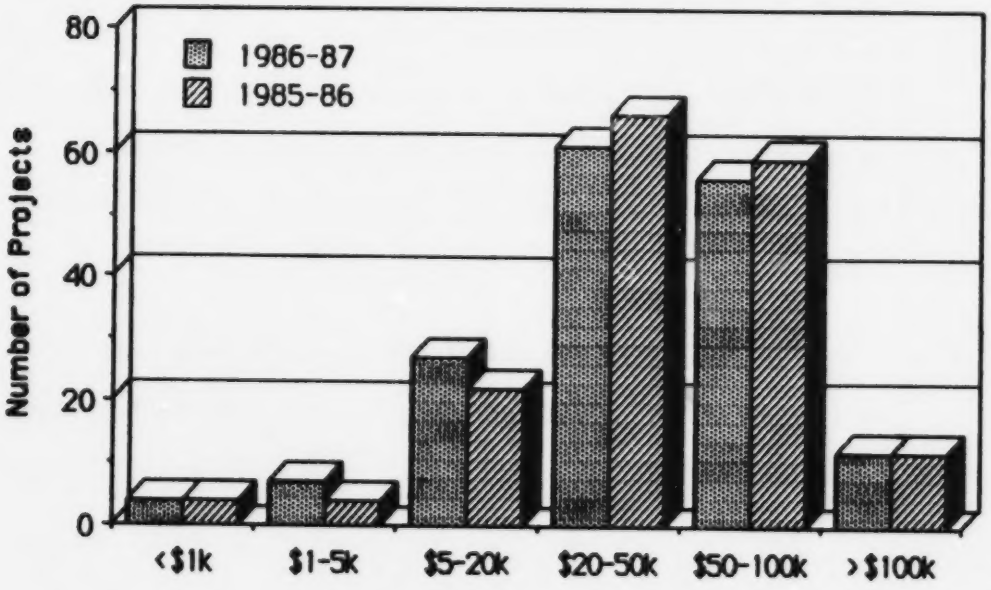
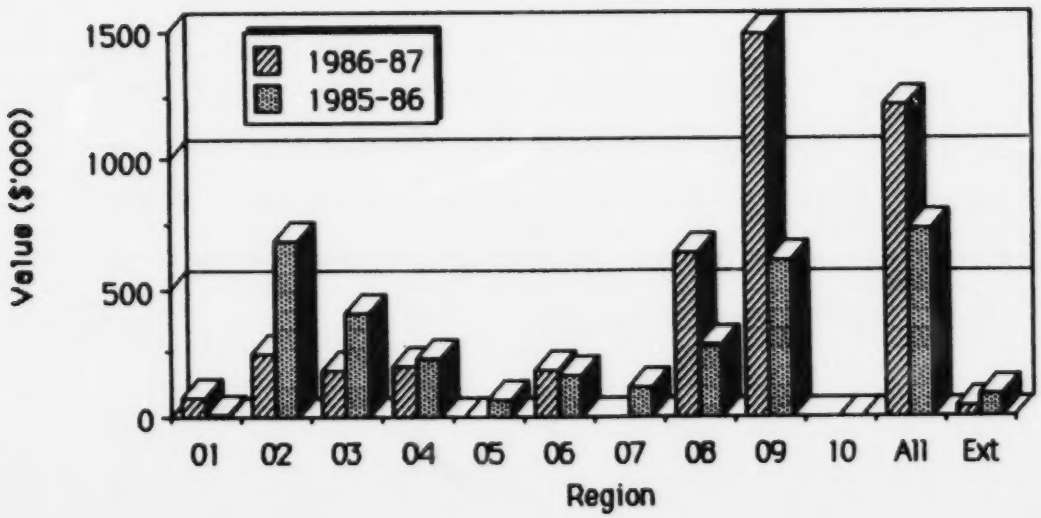


TABLE 10

DRM Resources by Administrative Region

REGION	1986-87			1985-86		
	Value $'000	(%)	Percent Funded	Value $'000	(%)	Percent Funded
01 Bas St-Laurent-Gaspesie	71.3	1.7	100.0	11.4	0.3	76.6
02 Saguenay Lac St-Jean	241.7	5.7	56.7	681.3	20.2	79.5
03 Québec	176.2	4.2	85.1	399.3	11.9	91.1
04 Trois-Rivières	193.7	4.6	86.0	225.9	6.7	82.1
05 Estrie	2.2	0.1	59.0	64.6	1.9	100.0
06 Montréal	174.0	4.1	98.9	162.8	4.8	89.9
07 Outaouais	0.0	0.0	—	116.1	3.4	94.4
08 Abitibi-Témiscamingue	642.0	15.2	98.1	281.0	8.3	37.0
09 Cote Nord	1489.7	35.1	91.1	612.2	18.2	66.8
10 Nouveau Québec	0.0	0.0	--	1.5	0.1	100.0
All Regions	1209.7	28.4	0.0	733.6	21.8	0.0
Outside Québec	37.1	0.9	100.0	83.3	2.5	100.0



- By project category

a) Funded projects

Funded projects made up the large majority of DRM activities in 1986-87. The principal details of these projects, and those of the two previous years are summarized in Table 11.

The following points can be observed;

- a considerable decrease in the total value of offers of service submitted with respect to the previous year, which included a one-time offer worth more than $800,000;

- new projects followed much the same patterns as during the previous year, where the number is similar to last year, but the total value is less;

- on the other hand, the value of projects completed during the year sharply increased when compared to the two previous years;

- the value of work on the order sheets at the end of the year totalled $618,000;

Table 12 shows that projects on order could be divided (47% vs. 53%) between the metallurgical research laboratory and the pilot plant. Projects were underway in every sector of DRM activities, while the precious metal sector lead the way with 27% of the total value of active projects.

TABLE 11

Funded Activities

	1986-87	1985-86	1984-85
Service Offers			
- Number submitted	107	122	86
- Value ($'000)	2,479.5	3,591.1	2,584.8
Funded Projects			
New Contracts:			
- Number	84	88	71
- Value ($'000)	2,003.9	2,700.6	1,921.4
Work undertaken:			
- Number	99	105	77
- Value ($'000)	2,721.6	1,888.7	1,880.6
Projects Completed:			
- Number	69	82	59
- Value ($'000)	2,979.1	1,908.8	1,950.9
Standard determinations ($'000)	119.4	167.7	153.4
Order Sheets at year's end ($'000)	618.1	1,094.5	486.0

TABLE 12

Order Sheets as of March 31, 1987

	LRM ($'000)	Pilot Plant ($'000)	DRM ($'000)
Industrial minerals	42.5	38.0	80.5
Precious metals	138.2	30.2	168.4
Iron ore	-	69.4	69.4
Niobium & other metals	64.3	37.8	102.1
Base metals	15.2	-	15.2
Process control	-	62.9	62.9
Miscellaneous	29.6	90.0	119.6
Total	289.9	328.2	618.1

Despite the intense activity brought about by the large number of funded projects, DRM nonetheless succeeded in vastly improving control over costs and meeting project deadlines. In fact, cost overruns with respect to estimates presented to clients were limited to 4.7% over the value of projects, compared to 10.6% the previous year, while 72.5% of final reports were delivered on time, compared to only 60.5% the previous year.

Table 13 summarizes information about our clientèle last year, as compared to the previous year;

- a similar number (45 vs. 46) of clients had work done by DRM personnel;

- the value of projects funded by small companies increased substantially, representing 55.4% of the total compared to only 18.9% the previous year;

- projects from new clients continued to represent a significant part of our work in 1986-87, for 37.7% of the total contract values;

- projects oriented to the development of new deposits accounted for 25.6% of the contracts, principally from companies in the precious metals sector;

- a significant proportion (16%) of projects in 1986-87 originated from companies providing services to the mining industry, including consulting firms, equipment and product manufacturers, and two universities.

TABLE 13

DRM Clients in 1986-87

New Contracts

	All Clients	Small Business	Large Corpor-ations	New Clients	Mining Industry Extraction	Mining Industry Operation	Mineral Benefi-ciation	Service to Mining Industry
1986-87								
Number of Clients	45	30	15	25	9	12	13	11
Number of Projects	84	52	32	37	15	26	23	20
Total Value ('$000)	2003.9	1109.6	894.3	756.2	512.5	910.2	260.7	320.5
Average Value ('$000)	22.6	21.3	27.9	20.4	34.2	35.0	11.3	16.0
Percentage (%)	100.0	55.4	44.6	37.7	25.6	45.4	13.0	16.0
1985-86								
Number of Clients	46	25	21	20	12	15	19	-
Number of Projects	88	36	51	27	18	35	34	-
Total Value ('$000)	2714.6	514.3	2200.2	1094.0	598.9	1591.3	524.3	-
Average Value ('$000)	30.8	14.3	43.1	40.5	33.3	45.5	15.4	-
Percentage (%)	100.0	18.9	81.1	40.3	22.1	58.6	19.3	-

b) Pilot Projects

Pilot projects are undertaken to evaluate problems submitted by clients so as to determine possible ways in which DRM may be of assistance, or to demonstrate the value of our expertise to hesitant clients.

Table 14 shows that few pilot projects were undertaken during the year, as only 11 projects with a total value of $44,600 were completed. Some of these led to contracts, particularly in the industrial mineral sector. The total value of these contracts was of the same order as the total cost of all the pilot projects.

c) Internal projects and research contracts

Internal projects and research contracts allowed us to maintain the level of our expertise and to assure quality service for the companies calling upon our services. In 1986-87, these projects represented 27.4% of all activities, with a value of close to $1.2 million.

Table 15 shows the distribution of these two types of projects by sector of DRM activity and classes them by three objectives namely;

- perfecting techniques : equipment and test methods (37.2%);
- development of new areas of expertise (44.4%);
- miscellaneous studies (18.4%).

TABLE 14

Pilot Projects

	Pilot Projects Completed		Projects Obtained	
	Number	Cost ($'000)	Number	Cost ($'000)
Industrial minerals	7	35.9	6	27.1
Precious metals	1	1.8	0	-
Iron ore	0	-	0	-
Non-ferrous metals	2	4.1	2	16.1
Niobium & other metals	1	2.8	0	-
Process control	0	-	0	-
Total	11	44.6	8	43.2

TABLE 15

Internal Projects and Research Projects

1986-87

('$000)

	Development of Techniques			Development of New Expertise			Studies			TOTAL		
	Int.	Cont.	Total	Int.	Cont.	Total	Int.	Cont.	Total	Int.	Cont.	Total
Industrial Minerals	12.0	-	12.0	-	-	-	113.8	-	113.8	125.8	-	125.8
Precious Metals	143.5	-	143.5	42.2	-	42.2	14.2	6.6	20.8	199.9	6.6	206.5
Non-Ferrous Metals	-	-	-	-	138.9	138.9	-	-	-	-	138.9	138.9
Iron Ore	36.7	-	36.7	-	46.7	46.7	-	-	-	36.7	46.7	83.4
Niobium and Other Metals	-	-	-	-	48.4	48.4	15.6	-	15.6	15.6	48.4	64.0
Process Control	126.5	-	126.5	-	245.0	245.0	-	-	-	126.5	245.0	371.5
Misc.	117.4	-	117.4	-	-	-	64.9	-	64.9	182.3	-	182.3
Total	436.1	0	436.1	42.2	479.0	521.2	208.5	6.6	215.1	686.8	485.6	1172.4

The development of our capabilities in the area of process control has once again demanded a large proportion of internal efforts, or 31.7% of the value of available resources. However, efforts in the industrial minerals and precious metals sectors increased over last year, so as to achieve a level of competence in the sectors where a growth in the demand for services is anticipated in the coming years.

The continuing development of techniques, including projects aimed at familiarizing ourselves with existing techniques or with newly acquired equipment, is carried out using only internal resources. On the other hand, the development of new areas of expertise is accomplished through research entrusted to university groups and our internal resources play a support role in these efforts.

Table 16 shows the principal research contracts completed in 1986-87. The amounts paid out to the organizations undertaking these projects totalled $313,400, to which internal resources valued at $165,000 were added in the form of tests and analyses. Studies to characterize iron ores in the agglomeration process (Ecole Polytechnique), on the bacterial leaching of processing tailings (Laval University), and on applied metallurgy for the processing of gold-bearing chalcopyrites in Québec (Laval University) were completed during the year and the results were made available to companies who could benefit from them.

TABLE 16

Research Contracts Awarded to External Organizations

1986-87

Title	Organization	Value ($)
Recovery of pyrochloric slimes by column flotation	McGill University	8,200
Physico-chemical characterization of iron ores and their behavior as conglomerates.	Ecole Polytechnique	18,600
Study of the physico-chemistry and hydrodynamics of the flotation process.	Laval University	48,000
Development of a selective flotation process for sulphides using electrochemical control.	McGill University	29,500
Development of data processing methods for mineralogical process data.	Laval University	50,500
Perfection of a methodology for simulating and scaling autogeneous and semi-autogeneous crushers.	Laval University	45,000
Alkaline screening of vanadium ore using plasma.	McGill University	35,500
Development of a super-reducible self-fluxing iron pellet.	Ecole Polytechnique	24,800
Bacterial leaching of waste ore solids.	Laval University	6,600
Development of a simulation model of the baking process for iron ore pellets.	Laval University	12,500
Electrometallurgy of gold-bearing chalcopyrites in Québec.	Laval University	39,200
TOTAL		313,400

- By sector of activity

a) Processing and Beneficiation of Industrial Minerals

During the past year, 53 projects worth a total of $562,000 were carried out in this sector, 59.8% of them with financial participation from a company. These projects represent 13.1% of the DRM activities in 1986-87, or a decrease of 15.6% with respect to the previous year. Internal projects with a value of $125,000 were undertaken by DRM personnel in this sector of activity.

The principal projects completed in 1986-87 are presented in Table 17. The following notes serve to illustrate the impact of certain projects;

- the development of a processing method for a talc deposit in the asbestos region (03), which could lead to the opening of a new mine;

- a study of the agglomeration of salt in long-term storage has identified methods which could control the problem;

- a number of projects on various aspects of processes used by a silicon carbide producer in Region 04 have led to improvements in the quality of their products;

- a method of processing silica fume waste from an iron-alloy producer in Region 04 was developed, and will allow storage of these residues in environmentally sound conditions;

TABLE 17

Projects - Industrial Minerals

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Funded Projects		
Extraction from a talc deposit (2413, 2432, 2485)	Carey Canada	57,920	R.Tremblay S.Dessureaux
Evaluation of the properties of a talc ore (2514)	International Larder	6,100	R.Tremblay
Study of the problem of agglomeration in stored salt (2486, 2512)	Mines Seleines Inc.	45,700	G.Delisle
Limestone Extraction (2450)	Y. et R. Paquette Inc.	3,700	G.Paquet
Extraction of quartzite for the glass industry (2440)	Entreprises Loma Inc	3,900	G.H.Cloutier
Improvement of the SiC manufacturing process (2345, 2400, 2431, 2433, 2453, 2468)	Norton Abrasives Division	64,700	R.Tremblay M.Nagamori R.Vachon
Development of a processing method for silica fume waste (2461, 2477, 2492, 2496, 2546)	SKW Canada Inc.	77,000	G.Gabra J.Pérusse G.Paquet
Recycling at the Magnaq-SNA plant (2447, 2530, AT-105)	SNA	11,600	J.J.Panneton
Baking porous clay (2466)	CRIQ	8,300	G.Paquet
Characterization of lime and limestone (2438, 2523)	Graybec-Jolichaux Inc	10,000	M.Nagamori G.Paquet

TABLE 17 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Funded Projects		
Defoliation of a schist in St-Apollinaire (2528)	Montréal Terra Cotta Ltd	3,100	S.Dessureaux
Various studies related to the production of metallic silicon (2437, 2543, 2493)	SKW Canada Inc	14,000	G.Paquet S.Caron D.Cotnoir
Consultation on various processes (2471, AT-107)	Shawbec Inc	8,900	J.Dionne M.Nagamori
	Pilot Projects		
Mica concentration in wastes (2388)	Marcor Inc	9,000	R.Tremblay
Calcite briquettes (2466)	Cap Equipments enr.	8,100	R.Tremblay
Alpha and Beta type Silicon Carbide (2482)	Norton	8,700	M.Nagamori
Separation of FeSi from a slag (2497)	SKW Canada Inc	2,900	G.H.Cloutier
Preliminary study of a talc concentrate (2502)	International Larder	6,200	G.H.Cloutier
Study of a sample of crushed silica	Calcite du Nord	1,100	R.Tremblay
Composition of an exothermic mantle (2436)	Pyrotek Ltd.	800	J.J.Panneton

TABLE 17 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Internal Projects		
Evaluation of possible ways to increase the value of industrial minerals produced in Québec (2489, 2490, 2491)	-	96,900	G.H.Cloutier A.J.Plumpton
Inventory of projects completed at CRM in the industrial minerals sector (2457)	-	9,800	M.Thérien
Preliminary study of various samples of industrial minerals supplied by DGEGM (2516, 2317, 2536, 2539)	-	6,000	G.H.Cloutier
Evaluation of dry crushers to produce fine particles (2474)	-	6,200	S.Dessureaux
Fine particle classification using a cyclone (2473)	-	3,600	S.Dessureaux
Development of a method of talc detection (2439)	-	2,200	R.Tremblay

- an exhaustive evaluation of possibilities to improves the value of industrial minerals produced in Québec had led to the identification of some interesting opportunities both in the area of fine ceramics and in feed materials for plastics.

A colloquium on research and development in the asbestos sector was held in October, 1986. This meeting served to point out industry needs and the directions to be favoured in R&D, with the aim of improving the competitive strength of this industry, which has been suffering from serious problems for many years.

Given the possibilities for developing new products which have been identified in the area of medium and high value industrial minerals, DRM will continue its involvement in this domain over the course of the coming year. In addition to working to acquire new knowledge in this area, pilot projects will be undertaken in collaboration with companies and other research organizations on the subjects of feed materials and fine ceramics. Also, collaboration with DGEGM will be emphasized so as to promote the identification of industrial mineral deposits whose development is seen to be promising over the coming years.

b) Processing Precious Metal Ores

In 1986-87, 32 projects with a value of $939,600 were carried out with 72.1% being industrially-financed. The work undertaken in this sector represents 21.9% of DRM resources, or an increase of 54.2% compared to the previous year. Internal projects with a value of $206,500 were also carried out with the

aim of improving the expertise and equipment available to companies in this sector.

The tremendous increase in activities in this sector is closely tied to the growing numbers of projects to develop new deposits which have been undertaken for "junior" companies in Québec.

The projects carried out in 1986-87 are presented in Table 18. The following projects were the most significant of these;

- pilot plant processing of about fifty tonnes of ore from Golden Pond East, in the Casa Berardi region (08), leading to confirmation of the potential of this deposit, where mining activities will begin in 1988;

- the development of a processing method for ore from the Astoria (08) deposit, for both bench testing and for in-plant processing of an 11,000 tonne sample; a decision on the mining potential of this deposit should be made this year;

- bench tests and pilot plant tests have been made on an ore sample from the Duvay (08) property, with the aim of more precisely evaluating the average concentration of this deposit;

- many projects were carried out for producers in Regions 02, 03, and 08, with the aim of improving recovery from their processing circuits;

- a carbon-in-pulp circuit with a capacity of 300 litres per hour was added to our processing circuit in the pilot plant and will allow the potential of this recovery technique to be evaluated during the continuous-feed processing of large ore samples.

TABLE 18

Projects - Precious Metal Ores

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Funded Projects		
Pilot plant processing of Golden Pond East ore (2521)	INCO Ltd.	263,100	J.Pérusse
Extraction of the Astoria deposit (2524, 2532, 2458)	Ressources Yorbeau Inc	207,700	G.Delisle R.Tremblay
Extraction of ore from the Duvay property (2513, 2522, 2531)	Exploration Sphinx Ltd.	73,100	G.Delisle J.Dionne R.Vachon
Preliminary evaluation of ore from the Malartic Audet property (2508)	Aurtec Inc	8,000	J.Dionne
Preliminary study of ore from the Tiblemont property (2515)	Ressources Maufort Inc	12,000	J.Dionne
Preliminary study of ore from the Lac Rose property (2560)	Ressources Eider Inc	2,700	J.Dionne
Precious metal recovery from electronic wastes (2533, 2550)	Recyclage Multi-Met Inc	21,800	J.Dionne
Improvement of the processing method for the Montauban deposit (2443, 2445)	Exploration Muscocho Ltd.	23,400	R.Tremblay

TABLE 18 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Recovery of free gold in wastes (2506, 2553)	Mines Northgate Patino Inc	11,900	G.Delisle
Distribution of gold in wastes (2505)	Falconbridge Copper Lac Shortt Division	5,200	J.Dionne
Heap leaching and mineralogical study (2503)	Mines d'Or Lac Bachelor Inc	13,800	G.Delisle
The effect of pyrite on cyanidation of ore (2472)	Mines Agnico Eagle Inc	2,200	R.Tremblay
	Pilot Projects		
Preliminary characterization of gold bearing sand (2537)	Canada Lafarge Cements	1,800	G.Delisle
	Internal Projects		
Modernization and development of a cyanidation circuit in the pilot plant (2232, 2520)	-	100,500	J.Pérusse
Development of the Carbon-in-Pulp process in the laboratory (2448)	-	21,800	J.Dionne

TABLE 18 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Development of the elution of active carbon in the laboratory (2463)	-	11,200	J.Dionne
Acquisition of basic skills in the electrolysis of solutions (2469)	-	42,200	H.Winter
Industrial fusion of gold precipitates (2480)	-	3,900	M.Nagamori
Study of the behaviour of the electromotive force during cyanidation (2348)	-	5,400	R.Tremblay
Stability of insoluble arsenic salts (2495)	-	2,200	G.Gabra
Literature study on the use of resins to recover precious metals during cyanidation (2548)	-	2,100	G.Gabra

During the coming year, the pilot plant processing circuit will be completed with the addition of an elution circuit and electrolysis cells for precious metal recovery. The pilot plant will then have a continuous processing circuit incorporating the latest technological developments. In addition, a study of the operation of six (6) gold ore processing plants presently in operation will be undertaken during the year, which will determine the potential for improvement of these installations.

Efforts aimed at increasing our activities with 'junior' mining companies in Québec will be pursued through the organization of a series of activities intended to make these clients more aware of the variety of services available from DRM.

c) Processing and Beneficiation of Iron Ores

Projects associated with this sector required the greatest proportion of DRM resources in 1986-87, with 34.4% of the total and a value of $1,474,000, or an increase of 90.5% over the preceding year. As 92.6% of these projects were funded, the contribution of the sector to DRM revenues was considerable, with 50.7% of the total income. A research contract on a study of the behaviour of Québec-Labrador concentrates in the agglomeration process was completed, while another research contract on the fabrication of super-reducible self-fluxing pellets continues, and will be completed in the coming year. The total value of all internal research projects and of research contracts in the iron ore sector was $83,400 in 1986-87.

Table 19 lists projects which were active during the past year. The principal results to be noted are:

- piloting a process to decrease the manganese levels in an iron concentrate from a producer in Region 09. This operation, requiring resources in excess of $800,000, concluded successfully by establishing the technical feasibility of this process. The company is presently evaluating the economic opportunities to continue the development of this process;

- significant efforts were also directed to a study of the phenomenon of reactivity in preduced iron pellets, and led to the identification of methods to control the problem in the plant, while at the same time identifying directions to follow in improving the behavior of Québec iron ore pellets;

- several projects undertaken in collaboration with a producer in Region 09, a chemical products manufacturer, and two university professors have led to the development of different type of pellets exhibiting improved properties both for use the blast furnace, and in direct reduction; these efforts are aimed at developing new, more profitable, markets for iron ore from Québec-Labrador;

- internal research continued to develop means of measuring various metallurgical properties of pellets and iron concentrates.

TABLE 19

Projects - Iron Ore

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Funded Projects			
Piloting a process to decrease the manganese concentration in an iron concentrate (2426)	Mines Wabush Inc	815,500	J.Pérusse J.J.Panneton
Study of reactivity phenomena in pre-reduced iron pellets (2464,2470)	Compagnie minière Québec-Cartier	169,700	I.Malinsky G.Paquet
Priming pre-reduced (2370)	Sidbec-Dosco Inc	17,500	I.Malinsky
Influence of fine ore on concentration (2423)	Compagnie minière Québec-Cartier	48,800	R.Vachon
Development of new, high-performance pellets (2483,2487)	Compagnie minière Québec-Cartier	94,500	G.Paquet
Application of various binders in pelletizing (2428)	Compagnie minière IOC Inc	43,200	G.Paquet
Study of iron pelletizing using polymers (2517)	Alchem Inc	8,000	G.Paquet
Reducibility of the source of iron concentrates (2509)	Compagnie minière Québec-Cartier	25,500	I.Malinsky
Development of pellets with improved properties (2454, 2455)	Ecole Polytechnique	32,000	G.Paquet

TABLE 19 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Development of pellets with properties similar to an agglomerate (2518)	McMaster University	21,000	G.Paquet
Consultation on pelletizing iron ore (2526)	Met-Chem Inc	13,500	G.Paquet
Study of baking ferrite pellets (2540)	Maghemite Inc	8,300	S.Dessureaux
	Internal Projects		
Measurement of the properties of iron ore pellets and agglomerates (2125)	-	16,500	I.Malinsky
Installation and break-in of the Linder test	-	16,000	G.Paquet
Refurbishing the pyro-metallurgy section at the pilot plant (2499)	-	3,900	A.Lemay
Follow-up to a research contract on the development of more reducible pellets (2346)	-	1,400	A.Lemay
Follow-up to a contract on the physico-chemical characterization of iron ores used as agglomeration fines (2197)	-	1,900	A.Lemay

During the coming year, activities in this sector should continue to be as intense, particularly in the study and development of new high-performance products. Internal efforts will be directed to improving the measurement of sticking between pellets in direct reduction, to developing simulation trials of the agglomeration process in the laboratory, and to establishing a suitable place in the pilot plant where all the iron ore evaluation trials can be performed.

d) Processing Non-ferrous Metal Ores

Fourteen (14) projects with a total value of $249,100, or 5.8% of the activities, were carried out in the sector of non-ferrous metal ores. This is an improvement of 70.7% over the previous year. However, only 43.4% of these projects were undertaken with industrial participation. Internal projects in this sector valued at $138,900 were completed under the terms of two research contracts. Laval University completed an evaluation of the electrometallurgical processing of gold-bearing chalcopyrites from Québec, which showed that the application of this type of process would be significantly less profitable than the pyrometallurgical processes currently being used by producers in the Chibougamau-Chapais region. Another research contract on the development of an electrochemical control method for the flotation of sulfidic Cu-Zn ores continued at McGill University.

Table 20 presents a list of projects underway in this sector. Note the following:

TABLE 20

Projects - Non-ferrous Metal Ores

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Funded Projects		
Consultation on various subjects (2135, 2544)	Noranda Research Centre	11,200	M.Nagamori
Preconcentration of copper from a slag (2435)	Noranda - Gaspé Mines	23,700	M.Thérien
Improvement of gold recovery in Mobrun ore	Ressources Audrey Inc	17,600	R.Tremblay
Processing residues from the zinc fabrication process (2456, 2498)	Zinc Electrolytique du Canada Inc	16,600	G.H.Cloutier G.Gabra
Extraction of a Cu-Ni ore (2519)	SODEMI - Ivory Coast	21,800	M.Thérien
Improvement of processing methods for used batteries (2416, 2529)	Nova Pb Inc	7,600	J.J.Panneton
Granulometric classification of aluminum powder (2462)	Cambro Inc.	6,000	R.Tremblay

TABLE 20 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Pilot Projects			
Recovery of lead oxide (2494)	Nova Pb Inc	2,100	G.H.Cloutier
Neutralization of weak acid using slag	Zinc Electrolytique du Canada ltée	2,000	M.Thérien
Internal Projects			
Follow-up to work on the electrochemical control of the flotation process for sulphidic ores (2314)	-	69,800	M.Thérien
Follow-up to work on the electrometallurgy of gold-bearing chalcopyrites in Québec	-	5,400	M.Nagamori

- a preliminary study with the aim of evaluating the possible production of a copper concentrate by a gravimetric method, using a smelting slag;

- a study of magnetic processing of residues from a zinc fabrication process, which demonstrated that this method was impractical due to the harsh conditions present in the processing environment;

- a preliminary evaluation of refining cupro-nickel ore from the Ivory Coast;

- collaboration with a company producing lead by recycling used batteries continued in 1986-87, which led to the identification of plant processes which could be improved;

During the coming year, DRM services will continue to be offered to non-ferrous metal producers in Québec as complementary services, since most of these companies are equipped to provide their own technical services. Internally, the research contract awarded to McGill University on electrochemical control of sulfide flotation will continue.

e) Processing Niobium and Other Metallic Ores

In 1986-87, eleven projects were active with a total value of $209,000, or 4.9% of available resources. This is considerably less (-62.6%) than the previous year. This drop in activity can be explained by the completion of work on processing methods for the Crevier deposit. Overall, 64.8% of the activities were undertaken with the financial participation of a company.

Projects completed during the past year are listed in Table 21, and include;

- continuation of a study of the gravimetric preconcentration of a pyrochloric ore from a producer in Region 02; this project was started the previous year and the customer decided not to follow up the project for the time being;

- a study to evaluate the possibilities of processing finer particles than the existing concentration process of a pyrochlore producer; this project may lead to improving the overall recovery of the process;

- a screening test was carried out on several tonnes of pyrochlore concentrate with the aim of improving the chemical quality;

- evaluation of a plasma process for titanium production was completed for a research center in Region 06;

During the coming year, the collaboration with the Québec pyrochlore producer will continue. Also, the research contract on the column flotation of pyrochlore fines will come to an end, while the development of a plasma process for the alkaline screening of vanadium ore will continue through a research project awarded to McGill University.

TABLE 21

Projects - Niobium and Other Metallic Ores

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Funded Projects			
Gravimetric Pre-concentration of Niobec ore (2420)	Services TMG Inc	19,300	A.J.Plumpton
Influence of finer particles on the concentration process for Niobec ore (2484, 2538)	Services TMG Inc	73,300	A.J.Plumpton
Screening a pyrochloric concentrate (2501)	Services TMG Inc	20,300	G.Paquet
Enrichment of flotation concentrates from Crevier ore (2357)	SOQUEM	15,400	G.Delisle
Electrometallurgy of titanium (2451)	IREQ	4,100	M.Nagamori
Elimination of chromium from plating plant effluents	Almex Inc	3,600	G.Gabra
Pilot Projects			
Characterization of plating plant effluents (2554)	Anacolor Inc	2,900	J.J.Panneton

TABLE 21 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Internal Projects		
Collection of pyrochlore using cheleating reactants (2089)	-	15,600	M.Thérien
Follow-up to a research contract on the recovery of pyrochloric slimes from column flotation	-	3,400	M.Thérien
Follow-up to a research contract on the development of a method for the alcaline screening of vanadium ore using plasma.	-	1,400	I.Malinsky

f) Control and Optimization of Mineralogical Processes

Activities in this sector included eleven (11) projects with a total value of $401,500, or about the same level as the previous year. This figure represents 9.4% of DRM resources; however, only 3.4% of the projects were undertaken with financial support from a company. Internal projects were undertaken, for the most part (66%), with the collaboration of GRAAIM at Laval University, under the terms of four research contracts. These projects were directed to the development of data processing methods for data gathered from industrial processes, as well as the modelling and control of operations used in processing plants, such as flotation, autogeneous crushing, and baking of iron ore pellets.

Table 22 presents the other projects undertaken in this sector during the year, including:

- the start of work on automation of iron ore pellet baking for a producer in Region 09;

- the continuation of a collaborative project with a company in Region 03, to improve the control of certain aspects of sawing granite;

- the design and testing of a data acquisition system for industrial transducers, which was successfully used on-site to monitor the pellet baking process.

During the coming year, in an effort to increase the extent of CRM involvement in every aspect of the application of computer

techniques, the various groups working within the three sections of CRM will be organized under the same technical division. In this way, we hope to improve the effectiveness of our work in the process control area through better coordination of each group's efforts. Within DRM, the main priority for the coming year continues to be the completion of a project to automate the iron ore pellet baking process. If successful, this project will contribute greatly to the recognition of our expertise in this domain.

TABLE 22

Projects - Control of Mineralogical Processes

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
Funded Projects			
Automation of process units in granite sawing (2378, 2479)	Granicor Inc.	4,100	M. Rémillard
Automation of iron ore pellet baking (2442)	Québec Cartier Mining Company	12,400	S. Caron
Internal Projects			
Design and Installation of a data acquisition system for industrial sensors (2441)	-	34,700	S. Caron
Technology Transfer (2286)	-	78,400	S. Caron
Automatic weighing of ore in the pilot plant (2430)	-	1,900	S. Caron
Study of autogeneous and semi-autogeneous crushing (2316,2337)	-	66,000	S. Caron
Follow-up to a research project on processing data from metallurgical processes. (2304)	-	10,700	S. Caron
Follow-up to a research contract on the study of ore flotation control (2308)	-	20,600	M. Thérien

g) Miscellaneous Projects

Projects found in this section cover activities which do not easily fit into one of the preceding sectors. Twenty-five projects with a total value of $445,900, or 10.4% of DRM resources have been included in this section. Table 23 presents these projects, of which 10.4% were funded. The principal projects are listed here;

- evaluation of the efficiency of column flotation for concentrating various ores, as marketing support for this equipment (manufactured in Québec);

- pilot-scale evaluation of a process for separating waste from telephone cables, developed at Laval University;

- development and installation of a plasma torch which is expected to be tested in the cement clinker fabrication process;

- development and improvement of various equipment and techniques;

- preparation of instruction booklets for the various test instruments and techniques used in our laboratories;

- following developments in high-technology sectors, such as plasma and biotechnology;

TABLE 23

Projects - Miscellaneous

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Funded Projects		
Evaluation of the efficiency of column flotation for concentrating various ores (2475, 2511, 2525 2545, 2551, 2555)	Column Flotation of Canada Ltd	41,500	R.Tremblay
Separation of waste telephone cables (2500)	Northern Telecom Canada Ltd	29,500	S.Dessureaux
Processing samples of incinerator wastes	Roche Ltd	5,100	R.Vachon
Characterization of various inorganic compounds	IGM	3,000	I.Malinsky
	Internal Projects		
Improvement of the power supply for the Jones magnetic separator (2298)	-	6,800	G.H.Cloutier
Familiarization with the operation of a plasma torch (2380)	-	10,700	A.Lemay
Familiarization with the Eriez high-intensity magnetic separator (2459)	-	9,600	S.Dessureaux

TABLE 23 (cont')

Title (Project number)	Client	Cost of work in 1986-87 ($)	Technical Authority
	Internal Projects		
Installation of and familiarization with the gas chromatometer (2563)	-	1,400	A.Lemay
Crushing curve and measure of the index of crushability of ores (2476, 2465)	-	16,100	R.Tremblay G.Delisle
Development of guidebooks to the operation of various instruments used within LRM (2218)	-	71,800	G.H.Cloutier
Inventory of equipment and ore in the pilot-plant (2504, 2460)	-	20,500	J.Turgeon A.Lemay
Computer applications in management at CRM (2109)	-	31,900	M.Rémillard
Use of plasma in pyro-metallurgy (2137)	-	7,800	M.Nagamori
Biotechnology applied to extractive metallurgy (2189)	-	4,700	G.Gabra

OBJECTIVES FOR 1987-88

During the coming year, our objective is to repeat the excellent performance of 1986-87. This is a sizeable challenge because, for the time being, it seems that we will not be able to count on having one very large project, as was the case this year. Consequently, we will have to rely more on persistent efforts to market our services.

Companies in the iron ore and precious metal ore processing sectors are expected to call upon our services for up to 60% of our funded projects. The improvement of existing products and the development of new products will form the principal projects carried out for producers in the iron sector. In the gold ore sector, collaboration with 'junior' companies in Québec in the development of new deposits should increase in the coming year, given the growing number of exploration projects which are reaching the extraction stage. The project to study six (6) operational plants should also lead to an increase in the level of our collaboration with companies.

In the industrial mineral processing sector, our efforts to develop more valuable materials will be continued. As well as expanding our expertise in the sectors of feed materials and ceramics, we expect to undertake a development project in the plastics sector, probably using talc, and also to finalize an agreement to collaborate with a producer of fine ceramics.

Finally, our efforts to maintain the highest level of quality in all our activities will be continued. The assurance to our customers of receiving the highest quality service is the primary measure of credibility for CRM, and at the same time constitutes the most reliable way for our customers to profit from the real benefits of the projects entrusted to us.

MINING TECHNOLOGY SECTION
Denis Cote, head

GENERAL OBJECTIVES

The Mining Technology Section (STM) of CRM undertakes and coordinates studies and work in the domain of mining operations with the aim of helping to optimize the profitability of companies. The section helps to promote the rational production of Québec's mineral substances. STM also encourages technology transfer to the various companies involved in the Québec mining industry and the coordination of human and technical resources available in Québec. In the objectives for 1986-87, STM had as a goal to devote 65% of the total available time to project activities of which 45% (29.5% of total time) would be funded by the Québec mining industry. The revenues from these projects, to be returned to the Government coffers, were expected to reach $103,000.

PERSONNEL AND RESOURCES

The activities of STM during the year 1986-87 were directed to supplying services to mining companies in the areas of ground control, industrial mining engineering, and computer applications for the mining industry. Such services seek specifically to supply technical aid to companies who cannot afford to pay for research and development teams or for technological assistance.

At the beginning of 1986-87, STM consisted of eighteen (18) employees: a section head, ten engineers, three technicians, a draftsman, and three secretaries. The personnel are divided into three divisions: Ground Control, Industrial Mining Engineering, and Computer Applications. During the year, STM acquired an electrical engineer and a computer programmer-analyst.

The Ground Control Division includes activities concerning ground stability, whether directly affected by mining activity or not. Such work calls upon conventional geomechanical techniques, as well as the new technologies of rock mechanics, monitoring instrumentation, and numerical simulation. The division operates a rock mechanics laboratory capable of performing most standard tests.

The Industrial Mining Engineering Division undertakes work directed to the optimization of various mining operations through technical innovations. STM is the only organization in Québec able to satisfy the needs of industry in terms of safety, verification, and installation of hoist equipment. Consequently, the latter activity is the most significant within the division.

The other services offered by this division cover ventilation, drilling, blasting, and computer-assisted planning of mining activities.

The Computer Applications Division contributes to the dissemination of technical information, and to the installation and use of computer equipment in mining operations. The goal is to maximize the transfer of technical know-how which provides users with appropriate, affordable, and efficient computer programs and assists companies in their choice of equipment. The computer installation at STM includes of a network of PC-based microcomputers. At the end of the year, the division acquired a MICRO-VAX II computer, which will speed the development of interactive graphics.

SUMMARY OF ACTIVITIES

The engineers and technicians in STM worked on a total of 102 projects during the year. Of this number, forty-nine (49) were funded, six (6) were awarded to outside firms, and forty-seven (47) were internal projects. The number of internal projects remained much the same as in 1985-86; however, the number of funded projects increased by 135%.

More than 35% of the funded projects had a value of over $10,000, while the majority (39%) fell between $5000 and $10,000 in value (Table 25).

Many internal projects (51.9%) had a value exceeding $10,000. Small and medium scale businesses in Québec profited

from the majority (38.3%) of these projects (Table 26). When tabulated by region (Table 27), Abitibi-Témiscamingue (Region 08) accounted for 48.4% of the project activity. The total cost of all the STM project activities reached $1,046,701.

During the 1986-87 year, many projects led to interesting results for the benefit of both mining companies and STM clients. The resources of STM were distributed as follows: 37% for Ground Control; 33% for Industrial Mining Engineering; 15% for Computer Applications; and 15% for the overall administration of the section.

Some research contracts were undertaken by external organizations (Table 28) who have expertise complementary to that of STM, so as to respond appropriately to certain needs of the Québec mining sector. In 1986-87, the personnel of the Mining Technology Section devoted 18,690 hours to projects, or 65.6% of the available time. The percentage of time directed to funded projects was 38.2% of the total time. Overall revenues exceeded objectives by 55%, reaching $160,000.

PRINCIPAL ACHIEVEMENTS OF 1986-87

In 1986-87 the Mining Technology Section made a considerable effort to promote technology transfer. In this vein, and with the collaboration of CANMET, the section organized three conferences in the Abitibi-Témiscamingue region, supported by the Québec Metal Mining Association Inc. (Association des Mines de Métaux du Québec inc). The themes around which these meetings were organized included crown pillar engineering, mining equipment,

and workplace health and safety. A round table bringing together Québec mining companies was also held, with the aim of establishing clear objectives for Québec in the development of mining equipment. During the year, the Mining Technology Section distributed a guide to rock bolt techniques, a guide to crown pillar design, a technical bulletin on the use of underground reservoirs for compressed air storage, and a technical bulletin on the use of the RPT30 tester for rock bolt holding-strength. More than a dozen presentations were made by STM personnel during these conferences and meetings.

The range of services offered by our rock mechanics laboratory was extended to include granite. To this end, the equipment specific to this industry was acquired, and services are now available to all the granite producers of Québec.

In environmental mining studies, STM concentrated on the problem of restoring acidic mining waste dumps. A research and development study was contracted to Roche Consulting Group Ltd. (Groupe conseil Roche ltée) to analyse the Solbec and Cupra mine sites.

DIFFICULTIES ENCOUNTERED

In 1985-86 the Mining Technology Section underwent a reorganization. After specific personnel needs were identified, a recruitment campaign was launched and the vacant positions were filled. Consequently, at the beginning of 1986-87, STM was able to start the year with a full team roster, and a well-padded order book.

The high number of part-time positions (7) remains a problem to all the activities of the section. The cramped and poorly laid-out quarters presently occupied by the section are also an impediment to efficient operations. A request was made to the Auxiliary Section of the Ministry that STM be moved as soon as possible. A new location has been found, and we are awaiting news concerning rental costs (from the Société immobilière du Québec).

OBJECTIVES FOR 1987-88

In 1987-88, STM will continue its present activities for the benefit of mining companies. The section will direct 34.8% of its resources to Ground Control, 29.2% to Mining Technology, 29.3% to Industrial Mining Engineering, and 7.3% to Computer Applications. Three types of projects activities will be undertaken in each of these areas, namely; technological assistance projects, in other words, projects formulated and requested by the private sector; research and development projects initiated by the engineers and professionals of STM in order to acquire skills and knowledge in a specific sector; and research contracts awarded to other organizations, universities, research centres, and consulting engineering firms, with the aim of studying or solving specific problems or of optimizing the use of the variety of resources available in the different regions of Québec.

In the Ground Control area, technical assistance services will be directed to using available tools to determine optimal dimensions for mine openings. Research and development work will concentrate on the mechanical properties of rocks, the design of underground workings, and blasting and bolting techniques.

Technological assistance in Industrial Mining Engineering will be directed principally to inspection and verification of mine hoists, mining geology, extraction methods, ventilation, and mining equipment. The results obtained in recent years from our research and development on mine hoists will soon be the subject of a guidebook to hoist operation.

Technological assistance in Computer Applications will be directed to the development of programs requested by clients, and on the study of their computer system needs. The following points have been identified as priority projects for research and development in computer applications for 1987-88;

- integration of all the software routines developed by STM;

- training of managers in the use of super micro-computers with sophisticated operating system which differ from the traditional DOS;

- on-site experimentation in underground mines with telemetry, remote surveillance, and remote control systems using microprocessors;

In Mining Technology projects under the "get it done" program, STM will coordinate four (4) studies which will be undertaken by organizations outside of CRM. These studies will involve mining productivity, rock bolt use, mining equipment, and evaluation of mineral reserves.

TABLE 24

STM Operating Budget

CATEGORY	FISCAL YEAR	
	1986-87 ($)	1987-88 ($)
SALARIES	705,300	773,300
OTHER OPERATIONS	312,700	252,300
CAPITAL	127,800	98,000
TOTAL	1,145,800	1,123,600

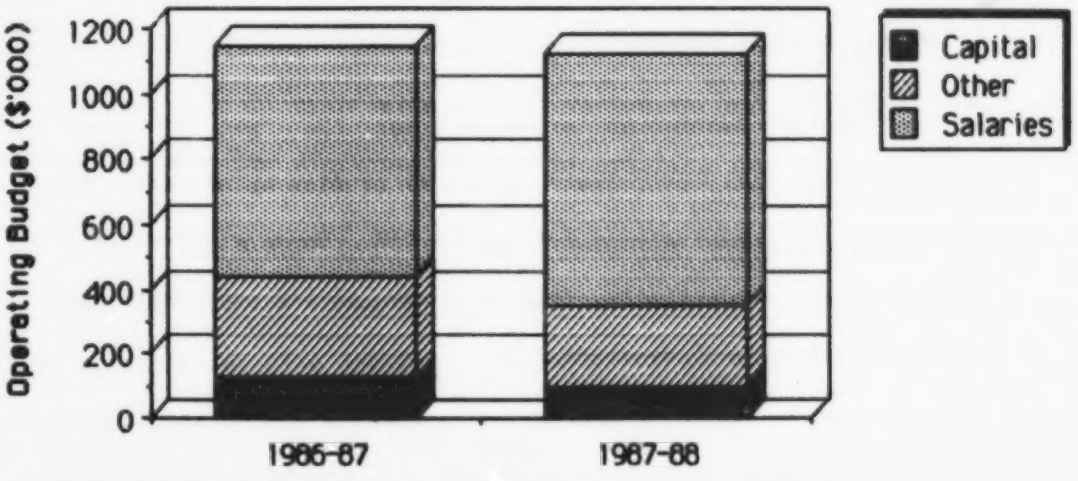


TABLE 25

Distribution of Projects by Value

1986-87

PROJECT VALUE	INTERNAL PROJECTS		FUNDED PROJECTS		TOTAL	
($'000)	N	%	N	%	N	%
50+	1	2.0	4	8.2	5	4.9
25-50	11	20.7	6	12.2	17	16.7
10-25	15	28.3	7	14.3	22	21.5
5-10	11	20.7	19	38.3	30	29.4
< 5	15	28.3	13	26.5	28	27.5
TOTAL	53	100	49	100	102	100

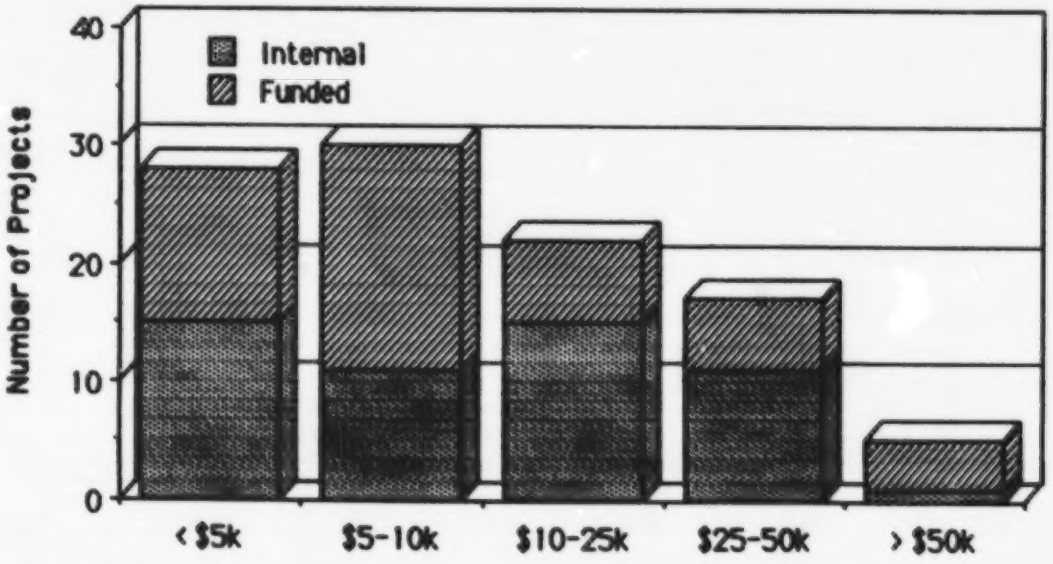


TABLE 26

STM Clients in 1986-87

CATEGORY	%
Government	6.3
Large Corporations	15.7
Small Businesses	38.3
Universities	1.8
Crown Corporations	6.8
Consultants	4.3
Client Groups	26.8

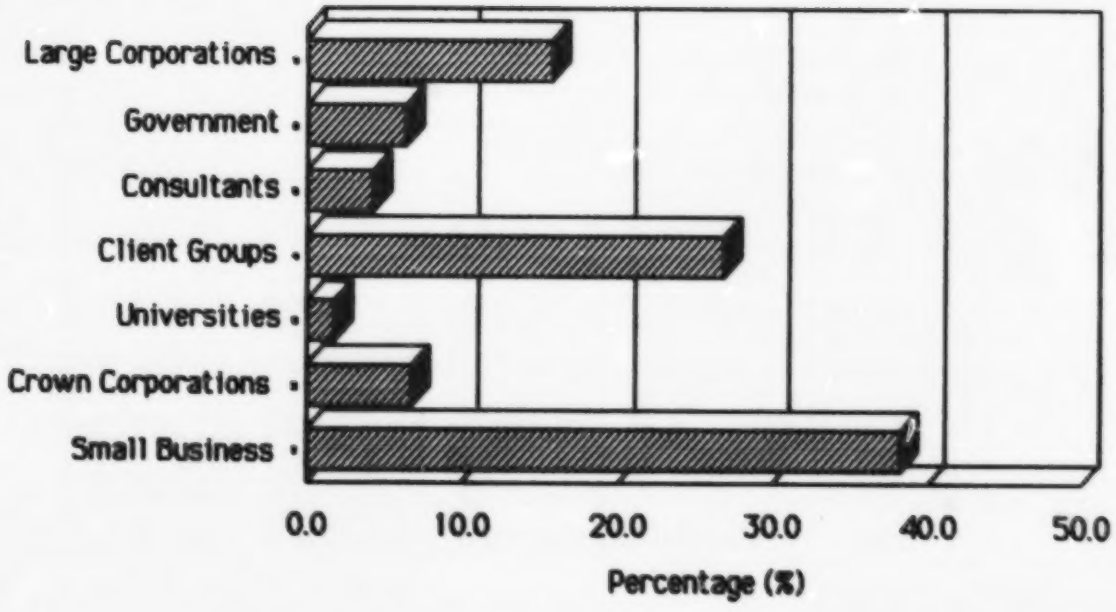


TABLE 27

Distribution of STM Clients by Region

1986-87

REGION	%
01 - Lower St. Lawrence, Gaspé, Madeleine Islands	4.2
02 - Saguenay-Lac St-Jean	11.3
03 - Québec	10.2
04 - Trois-Rivières	0
05 - Estrie	6.4
06 - Montréal	3.5
07 - Outaouais (Ottawa-Hull)	0
08 - Abitibi-Témescamingue	48.4
09 - Cote-Nord (North Shore)	15.9
10 - Baie-James (James Bay)	0
TOTAL	100

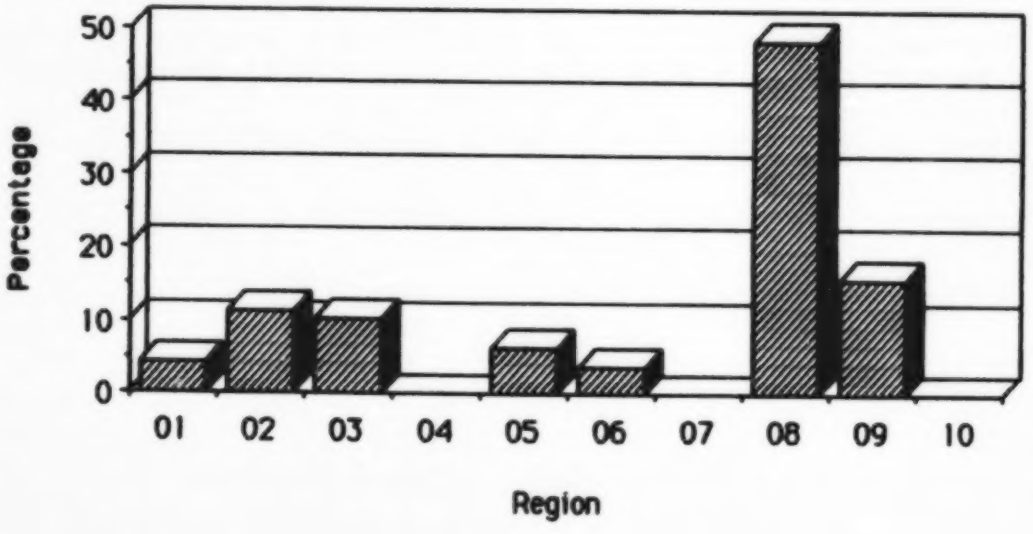


TABLE 28

Value of Research Contracts 1983-87

RESEARCH CONTRACTS	VALUE ($'000)			
	83-85	85-86	86-87	87-88
Rules for rock bolting, Phase II (Laval University)	30.6	19.5	13.6	—
Study of the cause and effect relationships between production bonus and productivity, profits, and safety. (Laval University) (Jointly Supported: CMR/AMMQ/CRM)	8.0	26.4	18.4	—
Geostatics applied to a three-dimensional module and on technology transfer at UQAT-UQUAT	—	—	20.0	—
Physical and mechanical properties of underground backfill and their effect on the design of underground workings. (McGill University)	—	20.9	24.7	—
Engineering guide for designing crown pillars - Groupe conseil Roche	—	39.2	19.6	—
Rehabilitation of sulphurous mine waste sites	—	—	81.4	—
TOTAL	38.6	106.0	177.7	—

ADMINISTRATION AND MARKETING SECTION
Albert Allard, head

GENERAL OBJECTIVES

The Administration and Marketing Section provides CRM with the administrative support essential to the smooth operation of the Centre. The activities of the section encompass financial management, scientific documentation, management computing services, and marketing.

At all times, the section must be able to provide CRM managers with the information necessary for them to operate efficiently in their respective fields of activity. On the other hand, the section takes direct charge of projects of general interest to CRM to assure their coordination and continuity, particularly when the central administrative units of the Ministry require special participation by CRM in the elaboration and treatment of specific dossiers.

PERSONNEL AND RESOURCES

The section consists of fifteen (15) full-time employees and two part-time employees, distributed among the four administrative divisions. Expenditures of the section reached $619,500, distributed as shown below, for each element of the program.

TABLE 29

Expenditures of the

Administration and Marketing Section

1986-87

Program Element	12.01 (DAM) ($'000)	12.02 (DRM) ($'000)	12.03 (STM) ($'000)	TOTAL ($'000)
Salaries	253.8	233.6	42.1	529.5
Operating	22.8	42.1	—	64.9
Capital	1.4	23.7	—	25.1
TOTAL	278.0	299.4	42.1	619.5

SUMMARY OF ACTIVITIES

One of the principal activities of the Administration and Marketing Section consists of providing all the managers within CRM with the information necessary to permit them to operate within the limits of their financial and material resources. Reports on various expenditures, the availability of credit, revenues, or any other financial matter are regularly supplied to support their decision making.

Table 30 shows in detail the state of expenditures and revenues for CRM during 1986-87.

Throughout the year, the section ensured the supply of goods and services to CRM, which represented a considerable number of transactions whose value reached nearly $1.5 million. The importance of our role within CRM cannot be overlooked; the members of the section must constantly work with CRM researchers and be prepared to react quickly to their requests so as to avoid any delays in the completion of their work.

The same can be said for the personnel working in scientific documentation who must assist researchers in their search for new scientific developments, through the acquisition and distribution of litterature pertinent to the research work at hand.

TABLE 30

CRM Expenditures and Revenues

1986-87

EXPENDITURES	1984-85 $'000	1985-86 $'000	1986-87 $'000
Operations			
1- Salaries	4,715.6	4,600.4	4,677.7
2- Other renumeration	220.5	162.6	301.3
3- Communications	139.3	120.4	166.1
4- Services	420.6	529.5	618.7
5- Maintenance	70.5	51.1	99.5
6- Rent	18.5	18.3	28.5
7- Supplies	719.7	516.3	481.7
11- Other Expenditures	29.5	27.5	4.1
TOTAL	6,334.2	6,026.1	6,377.9
Capital			
8- Equipment	946.9	1,187.1	778.7
9- Buildings	207.9	67.8	74.9
TOTAL	1,154.8	1,254.9	853.6
Transfer			
10- Grants	--	--	--
TOTAL EXPENDITURES	7,489.0	7,281.0	7,231.5
Budget	7,598.0	7,634.4	7,193.3
Unused Credits	110.0	353.4	(38.2)
REVENUES			
Metallurgical Research	437.0	564.0	721.7
Mineral Analysis	56.9	105.5	84.7
Mining Technology	55.0	93.7	161.2
TOTAL	548.9	763.2	967.6

In marketing, the section was actively involved in several projects;

- Logistical organization of eight colloquiums, including three in the Val-d'Or region, and the publication of a number of conference proceedings and discussion papers from these meetings;

- Visits to approximately 150 mineral processing plants and mining companies;

- Distribution of publicity and general information to clients;

- Development of an information bank on CRM clients;

In administration, the section carried out studies of several subject areas, including;

- the financial policy of Québec and Canada with respect to research and development;

- the rates charged for CRM services;

- a survey of financial programs for small businesses (mines);

- installation of a new computerized system for cost-management of research projects;

- study of the implications of a change in the status of CRM;

- the impact of a group of CRM research projects between 1981 and 1986;

- a survey of research projects at universities;

- presentation guide for projects submitted to CRM for financing;

- management of CRM research projects during 1987-88.

OBJECTIVES FOR 1987-88

The role of the Administration and Marketing Section has now become very well defined, because it was decided that operational units of CRM constitute the primary clientèle of the section. Given this fact, the section should to the best of its material and, especially, human resources, offer these units ready assistance in the areas of administration, financial management, technical documentation, management computer services, and marketing.

During 1987-88, the Section will pay particular attention to the achievement of two activities essential to the smooth operation of CRM. These activities are the installation of a new project management system, and increased use of computers in the preparation of various monthly reports.

The computer division will therefore have the responsibility to carry out these projects in accordance with the expressed needs of the operational units within the Centre.

PRESENTATIONS AT CONGRESSES AND CONFERENCES

DE BLOIS, C.

"Simultaneous detection of rare earths in rocks and minerals by AEPS", 54th l'ACFAS conference, University of Montréal, May 12-16, 1986

DE BLOIS, C.

"ICP/AES and SAA: a difficult choice" Colloquium on Atomic Emission Plasma Spectroscopy applied to mineral analysis, Québec, October 21-22, 1986

EVERELL, M.D.

"CRM working for the gold mines in the north-west"
Colloquium on Applied mineralogy
Val d'Or, March 26, 1987

EVERELL, M.D.

"Lessons from other country's mineral research systems"

Panel on Promoting Automation in Canadian Mining, Symposium on Applications of Automation in Mining, Present and Future.
Sudbury, October 14-16, 1986

GAGNE, R.

"Quality Assurance in Mineral Analysis" 54th l'ACFAS conference University of Montreal, May 12-16, 1986

WILHELMY, J.F.

"Application of two new analytical techniques to mineralogical studies" ICM Congress, Montreal, May 11-15,1986

WILHELMY, J.F.
"Applied Mineralogy: a source of profits for the mining industry"
Colloquium on Applied Mineralogy
Val d'Or, March 26, 1987

PUBLICATIONS BY CRM PERSONNEL

BRINDAMOUR, R. and LE HOUILLIER, R.

"Methods for precious metal detection
in various mineral substances"
October 1986, AC-10 (63 pages)

GAGNE, R. and GUIMONT, J.

"Methods for detecting various
mineral substances using atomic
absorption spectrometry and atomic
emission plasma spectroscopy.
July 1986, AC-11 (420 pages)

EXTERNAL ACTIVITIES OF CRM PERSONNEL

Québec Association of Industrial Research Directors (ADRIQ)	
Secretary-treasurer (until December 2, 1986)	
Info-ADRIQ, editor (until May 1986)	M.D.Everell
National Research Council of Canada	
Member of the reviewing committee Materials Engineering Institute (IGM)	M.D.Everell
Chairman of the reviewing sub-committee of IGM on ceramics and materials on composite metallic matrices	M.D.Everell
Government of Québec	
Ministry of Energy and Resources	
Member of the advisory committee to the Mining Technolgy Section	M.D.Everell
Member of the CRM consultative committee	M.D.Everell
Member of the Mining Division committee	M.D.Everell
Canadian Institute of Mining and Metallurgy (CIMM) - Québec section	
Ex-officio member	M.D.Everell

EXTERNAL ACTIVITIES OF CRM PERSONNEL (cont')

Joint Conference of the National Conference on the Advancement of Research and the Canadian Research Management Association, Québec, September 1986

Organizing Co-Chairman	M.D.Everell

Ministry of Energy, Mines and Resources (Canada)

CANMET

National Advisory Committee on Research in Mining and Metallurgy (NACMMR)

Committee Member	M.D.Everell
Member of the sub-committee on Mining Technology	M.D.Everell

First International Conference on Asbestos Cement Cannes, France, May 1986

Member of the Program Committee	M.D.Everell

Laval University

Member of the Mining Engineering Program Committee	M.D.Everell

---

Government of Québec

Complexe scientifique Emergency Committee

Committee members	M.Gagnon N.Zaprianoff

Québec Standards Committee (BNQ)

Committee Member	R.Gagné

EXTERNAL ACTIVITIES OF CRM PERSONNEL (cont')

Human Resources Office Selection Committee	
Committee Members	J.M.Deschamps J.Guimont M.Pichette
Central Supplies Records Committee	
Committee Member	M.Pichette
Committee on Employment Levels	
Committee Member	M.Pichette
Québec Order of Chemists	
Investigator on the Professional Inspections Committee	R.Gagné
Québec Order of Technologists in Applied Science	
Chairman of the board of directors and President (Québec region)	A.Tremblay
Laval University	
Lecturer in a course in Iron-Making	R.LeHouillier
Member of the Engineering Physics committee	R.LeHouillier
Member of the program committee for Metallurgy	R.LeHouillier

MEMBERS OF THE CRM ADVISORY COMMITTEE

GILLES BARBERY
Chairman
Mining and Metallurgy Department
Laval University
SAINTE-FOY (Québec)
G1K 7P4

JACQUES R. BEAUREGARD
J. Beauregard & Associes
81, rue Sainte-Pierre
QUEBEC (Québec)
G1K 4A3

CLEMENT DESROCHERS
Consultant
Clément J. Desrochers
et Associes Inc.
3135, rue Chambord
SAINTE-FOY (Québec)
G1W 2X6

MARC-DENIS EVERELL
Director General
Centre de recherches minérales
Ministére de l'Energie
et des Ressources
2700, rue Einstein
SAINTE-FOY (Québec)
G1P 3W8

J.M. REJEAN GAGNON
Vice-President of Marketing
Québec-Cartier Mining Company
1801, McGill College, Suite 1400
MONTREAL (Québec)
H3A 2N4

JOHN GRUZLESKI
Chairman
Mining Engineering and
Metallurgical Engineering Dept.
McGill University
MONTREAL (Québec)
G5B 2H3

ROGER MORISETTE
President
Shawbec Inc.
C.P. 890
SHAWINIGAN (Québec)
G9N 6W2

MICHEL RIGAUD
Professor
Metallurgical
Engineering Department
Ecole Polytechnique
P.O. Box 6079, Station A
MONTREAL (Québec)
H3C 3A7

MICHEL RODRIQUE
Director
Les Services TMG Inc.
P.O. Box 70
SAINT-HONORE (Québec)
G0V 1L0

GILBERT ROUSSEAU
President
Exploration minière Vent d'Or
98, rue Guay
VAL D'OR (Québec)
J9P 4Z7

MICHEL GARON
Director
Opemiska Division
Minnova Inc.
P.O. Box 10
CHAPAIS (Québec)
G0W 1H0

ONIL ROY
Deputy Minister (mines)
Ministère de l'Energie
et des Ressources
1620, boulevard de l'Entente
QUEBEC (Québec)
G1S 4N6

GERARD CASTONGUAY
Centre de recherches minérales
Committee Secretary

MEMBERS OF THE ADVISORY COMMITTEE FOR THE CRM MINING TECHNOLOGY SECTION

CLAUDE BOURGOIN
Professor
Mining and Metallurgy Department
Laval University
SAINTE-FOY (Québec)
G1K 7P4

DENIS COTE
Head, Mining Technology Section
Centre de recherches minérales
Ministère de l'Energie
et des Ressources
2700, rue Einstein
SAINTE-FOY (Québec)
G1P 3W8

BERNARD COULOMBE
Director
Jeffrey Mines
JM Asbestos
ASBESTOS (Québec)
J1T 3N2

MARCEL DE ROUIN
PEMP Inc.
Canada Place
1010, de la Gauchetière W.
MONTREAL (Québec)
H3B 2N2

CLAUDE DROUIN
Executive Director
Québec Metal Mining Assoc. Inc.
2, Place Québec, Suite 704
QUEBEC (Québec)
G1R 2B5

MARC-DENIS EVERELL
Director General
Centre de recherches minérales
Ministère de l'Energie
et des Ressources
2700, rue Einstein
SAINTE-FOY (Québec)
G1P 3W8

DENIS GILL
Professor
Mining Engineering Department
Ecole Polytechnique
University of Montréal Campus
P.O. Box 6079, Station A
MONTREAL (Québec)
H3C 3A7

YVAN GODBOUT
Director General for the
Mining Industry
Ministère de l'Energie
et des Ressources
1620, boulevard de l'Entente
QUEBEC (Québec)
G1S 4N6

JACQUES NANTEL
Head of the
Mining Technology Division
Noranda Research Center
240, Hymus Blvd.
POINTE CLAIRE (Québec)
H9R 1G5

RAYNALD VEZINA
Director
Kiena Gold Mines Ltd.
C.P. 9000
VAL D'OR (Québec)
J9P 6A5

SERGE VEZINA
Asst. Executive Vice President
QIT Fer et Titane Inc.
C.P. 560
SOREL (Québec)
J3P 5P6

JEAN-MARC ROBERT
Centre de recherches minérales
Committee Secretary

CRM PERSONNEL

DIRECTOR GENERAL

Director General
Marc Denis Everell, Eng. D.Sc.A.

Secretary
Colette Kirouac

Assistant Director General
Gérard Castonguay, Eng., M.A.P.

RESEARCH AND DEVELOPMENT

Director
Alain Claveau, Eng., D.Sc.A.

Secretary
Laurette Langlois

METALLURGICAL RESEARCH LABORATORY

Head
Jean Gobeil, Eng., M.Sc.A.

Secretary
* Louise Lavoie

Office Clerk
Monique Boivin

Technical Support

Georges Keays
Fernand Savoie
Herman Dombrowski
** Cécile Magnan

Industrial and Precious Metal Minerals

Group Coordinator
Georges H. Cloutier, Eng., B.Sc.A.

Research Professionals
Gennard Delisle, Eng., M.Sc.A.
* Jean Dionne, Jr.Eng.
Georges Gabra, D.Sc.A. (Chem.)
** D. Kougioumoutzakis, B.Sc.(Chem.)
Michel Rémillard, Eng. D.Sc.A.

Technicians
Magella Bédard
Edouard Chrétien
Carol Desbiens
Marc-André Malenfant
Michael Mooney
Pierre Perreault
Jacques Simard

Laboratory assistance
Bertrand Paquet

Metallic Minerals

Group Coordinator
Rémi Tremblay, Eng., B.Sc.A.

Research Professionals
Ivan Malinsky, Eng., D.Sc.A.
Meguru Nagamori, Eng., Ph.D.
Jean-Jules Panneton, Eng., M.Sc.A.
Arthur J. Plumpton, Eng., Ph.D.
Michel Thérien, Eng., D.Sc.A.

Technicians
Jean-Eudes Comtois
Dianne Gilbert
Jean-Guy Lafrance
Jean-Yves Paquet
Yves St-Louis
Jules Samson

PILOT PLANT

Head
Gontran Foy, Eng., B.Sc.A

Assistant Head
André Lemay, Eng., B.Sc.A.

Secretary
Denise St-Germain

Typing
Micheline Auger

Stores
Lévis Turcotte

Hydrometallurgy

Group Coordinator
Jacques Pérusse, B.Sc. (Chem.)

Pyrometallurgy

Group Coordinator
*Guy Paquet, Eng. B.Sc.A.

Chief Laboratory Technician
Jean-Louis Blais

Mineral Processing
André Blais

Mineralogy

Group Coordinator
Silien Dessureaux, Eng., M.Sc.A.

Research Professionals
Robert Vachon, Eng., B.Sc.A.
Jacques Turgeon, Eng. B.Sc.A.
Sylvain Caron, Eng. M.Sc.

Chief Laboratory Technician
Léo Lemieux

Technicians
* Ghyslain Dubé
Jacques Dumas
* Claude Gilbert
Jean-Luc Latulippe
* Gaétan Paradis
Maureen Poiré
* Jean Robitaille
Jean-Paul Veilleux

Technical Support

Group Coordinator
Marcel Defoy

General Assistant
Gilles Blais

Specialized Workers
Siméon Matte
Paul-André Guay
Clement Fréchette

Laboratory Assistance
** Jean-Charles Richard

Workers
Roger Côté
Yvan Laliberté
Alfred Dupuis

ANALYSIS AND CONTROL

Director
Marc Pichette, B.Sc.A., Dpl.Adm.

Secretary
Ghislaine Lamontagne

Coordinator
Claude Samson, B.Sc.A. (Phys.)

CHEMISTRY

Head
Jean Guimont, M.Sc. (Chem.)

Secretary
* Danielle Goulet

Technicians
Christiane Dallaire
Christine Tremblay

Laboratory Assistance
Jean P. Bergeron

Atomic Absorption

Division Head
Raymond Brindamour. B.Sc.(Chem.)

Chief Technician
Jean-Paul Lemay

Technicians
Mario Gagnon
Roger Genest
Pierre Plourde

General Chemistry

Division Head
Nicolas Zaprianoff, Chem.Eng.

Chief Technician
Jean-Marc Deschamps

Technician
Marie-Berthe Gauvreau

Plasma

Division Head
Robert Gagne, B.Sc. (Chem.)

Chief Technician
Guy Vallières

Technicians
Jacques Bélanger
** Aline C. Gagnon
André Labonté
Marjolaine Morency
* Hélène Ferland
* Denise Rhéaume
* Linda Roy

General Assistance
Jeannine Beaumont

Analytical Research

Division Head
Roland LeHouillier, Eng., D.Sc.A

Chemists
*** Helmut Winter, D.Sc.
Carol Deblois, B.Sc. (Chem.)

Chief Technician
** Normand Rhéaume

Technicians
Alain Tremblay
Guy Tremblay

PHYSICS AND MINERALOGY

Division Head
Simon Turmel, B.Sc. (Physics)

Secretary
Francine Poulin-Coté

Computers and Instrumentation

Division Head
Louis Barrette, D.Sc. (Physics)

Chief Technician
Richard Morasse

Technicians
Jean-Guy Chartrand
Claude Champagne

Mineralogy

Division Head
Bernard Kieller, M.Sc. (Geology)

Mineralogist
Jean-François Wilhelmy, Eng. M.Sc.
* Gaétan Gauthier, B.Sc. (Geology)

Chief Technicians
Jacques Cantin
Claude Coté
Daniel Moisan

Technician
André Dumont

Spectrometry of Solids

Division Head
Jacques Boivin, D.Sc. (Phys.)

Chief Technician
Jacques Tremblay

Technicians
Jacques Chabot
Jacqueline Mailloux
Régent Marcoux
* Johanne Marceau
* Hélène St-Pierre

MINING TECHNOLOGY

Head
Denis Côte, Eng.

Associate Head
Jean-Marc Robert, Eng., M.Sc.A.

Secretaries
* Lorraine Giroux
* Hélène Létourneau
* Gisèle T. Aubé

Draftsman
Michel Fournier

Ground Control

Head
Louis Bienvenu, Eng.

Project Leaders
* Denis Labrie, Eng., M.Sc.A.
Louis Marcoux, Eng., B.Sc.A.
Christian Morin, Eng.

Laboratory Technicians
Richard Grenier
Denis Ouellette

Industrial Mining Engineering

Chief
(vacant)

Project Leaders
* Dorien Caron, Eng.
Jean-Guy Dionne, Eng., B.Sc.A.
* Hermann Héon, Eng. B.Sc.A.
Roger Demers, technician

Computer Applications

Head
Patrice Live, Eng. B.Sc.A.

ADMINISTRATION AND MARKETING

Head
Albert Allard, Eng., B.Sc.A.

Secretaries
Line Godbout
* Johanne Marcotte

Marketing

Head
Sami S. Nosseir, Eng., M.Sc.A.

Administration Officer
** Daniel Filion, Adm.A. B.A.A.

Research and Socio-Economic Planning
Antoine Ahua, Eng., M.A.

Purchasing and Financial Management

Head
Roger Pagé, r.i.a.

Verification
André Morel
Serge Dorval

Purchasing
Noel Pouliot
Richard Auclair
* Raymond Levesque

Scientific Documentation

* Head
Patrice Bélanger, Eng. B.Sc.A.

Library
Lucie Darveau
Rita Martineau

Secretarial Services

Head
Gilberte Pépin

Receptionist
** Rose Demers
Marie-Paul Légaré

* Part-time employees
** Departed during the year
*** Within LRM

CENTRE DE RECHERCHES MINERALES

1986-87 ANNUAL REPORT

Translated from the original French by:

SCCON SCIENTIFIC RESEARCH INC.
Box 453, Sillery, PQ. G1T 2R8

Gouvernement du Québec
Ministère de l'Énergie et des Ressources
Centre de Recherches minérales